



Fisheries and Oceans
Canada

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Science

Sciences

Canadian Science Advisory Secretariat
Science Response 2014/017

Maritimes Region

MARITIMES RESEARCH VESSEL SUMMER SURVEY TRENDS

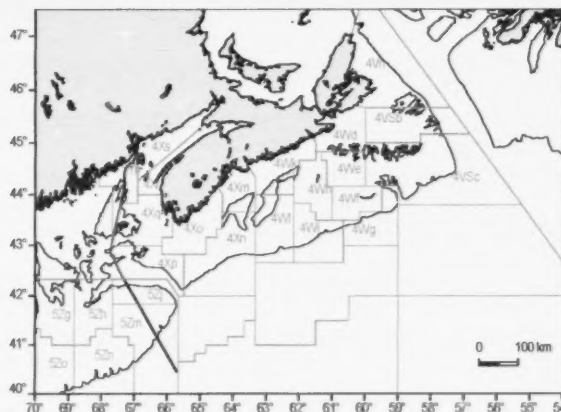


Figure 1: Northwest Atlantic Fisheries Organization (NAFO) Unit Areas.

Context

DFO has conducted summer research vessel (RV) surveys in the Maritimes Region, Northwest Atlantic Fisheries Organization (NAFO) divisions 4VWX and a small portion of 5Y, using a standardized protocol since 1970. Results of these surveys provide information on trends in abundance for most groundfish species in the Maritimes Region. While these data reflect trends in biomass and abundance and are a critical part of science-based stock assessments, a full assessment, including other sources of data, would be required to evaluate the impacts of management measures on population status. Fisheries and Aquaculture Management (FAM) requested a review of the DFO RV survey information on the following list of fish stocks: 4Vn Atlantic Cod, 4VsW Atlantic Cod, 4X5Y Atlantic Cod, 4VW Haddock, 4X Haddock, 4VW White Hake, 4X White Hake, 4VWX Silver Hake, 4VWX+5 Pollock, Unit II Redfish, Unit III Redfish, 3NOPs4VWX+5 Atlantic Halibut, 4VW flatfish, 4X5Y flatfish, 4VW and 4X Smooth Skate, Thorny Skate, Barndoor Skate, Winter Skate, Little Skate, Atlantic Wolffish, Monkfish, and Longhorn Sculpin. Full assessments will not be conducted for these stocks in 2013. In addition, biomass trends relative to accepted biomass reference points were requested for White Hake (biomass for lengths > 41 cm) and Unit III redfish (biomass for lengths > 22 cm). The survey information will be used by DFO Resource Management as background for discussions with various industry stakeholders on recommendations for management measures, and to determine which stocks should be reviewed in more detail in 2014.

This Science Response Report results from the Science Response Process of December 18, 2013, on the Review of Maritimes Research Vessel Survey Trends.

Background

The DFO summer research vessel (RV) survey of the Scotian Shelf and Bay of Fundy has been conducted annually since 1970. The surveys follow a stratified random sampling design, and include sampling of fish and invertebrates using a bottom otter trawl. These surveys are the

primary data source for monitoring trends in species distribution, abundance, and biological condition within the region. There were changes to the net used and the vessel conducting the survey in 1982 and 1983, along with some changes in data collection protocols. These changes may affect the biomass trends for some species. For long-term averages, the most appropriate starting point has been selected for each species (for details see Clark and Emberley, 2011).

The bottom trawl surveys were designed to provide abundance trends for fish and invertebrates between depths of about 30 m to 400 m. Survey indices are expected to be proportional to abundance for most species.

Strata boundaries are shown in Figure 2 for the 4VWX5 area. Sampling was conducted in all 4VWX strata, and in the deeper strata of area 5Zjm. Catch distribution plots for the entire summer RV survey area are provided for a suite of species which are commonly caught in the 4VWX groundfish fishery. Biomass index trends are shown for the area appropriate for each stock. Comparisons of 2012 and 2013 length frequencies from the survey catch to the long-term mean (from beginning of survey series, or the period deemed appropriate for that particular species, to 2011) are also included, using data from the geographic areas that are used in assessments for those stocks.



Figure 2. 2013 Summer RV Survey strata.

Analysis

The time-series of survey biomass indices are compared to averages for a series of time periods to provide historical context for biomass levels. The time periods used are a short-term 5 year average (2007-2011), a medium-term 15 year average (1997-2011), and the long-term survey average (1970-2011) (Table 1).

Table 1. RV survey biomass indices for species by stock/region for 2011, 2012, 2013, and averages for short-term 5 year (2007-2011), medium-term 15 year (1997-2011), and long-term (1970-2011) time periods.

Stock/Region	2013	2012	2011	2007-2011 Avg	1997-2011 Avg	1970-2011 Avg
4X Atlantic Cod	2,058	3,268	3,775	6,413	11,202	20,963
4VsW Atlantic Cod	9,525	4,709	27,771	32,681	17,121	52,926
4Vn Atlantic Cod	966	1,561	4,229	4,934	4,902	15,723
4VW Haddock	43,461	30,540	28,763	71,043	63,689	60,157
4X Haddock	36,580	28,980	47,874	50,470	54,999	57,123
4VW White Hake	2,868	1,933	5,191	5,393	5,859	10,157
4X White Hake	7,443	7,934	9,365	13,110	11,543	18,845
4VWX Silver Hake	35,461	48,166	51,918	32,376	25,845	*35,535
Western Component Pollock	26,823	5,981	8,111	28,381	26,417	31,120
Eastern Component Pollock	33,006	35,968	153,057	53,384	24,384	27,378
Unit II Redfish	23,233	14,586	56,236	61,869	40,377	50,522
Unit III Redfish	77,123	203,943	213,287	194,748	117,840	114,572
4X American Plaice	312	767	858	1,213	1,416	2,085
4VW American Plaice	19,559	7,900	9,600	13,481	16,323	24,252
4X Witch Flounder	869	731	488	1,357	1,569	1,849
4VW Witch Flounder	4,773	3,977	5,119	5,725	4,180	3,959
4X Yellowtail Flounder	102	332	725	755	892	684
4VW Yellowtail Flounder	14,646	9,371	11,615	11,869	10,554	13,644
4X Winter Flounder	6,448	6,295	3,589	6,712	4,994	3,444
4VW Winter Flounder	426	556	740	497	818	912
4VWX Atlantic Halibut	8,656	7,685	6,777	6,896	4,143	3,298
4X Atlantic Wolffish	10	309	638	343	995	2,153
4VW Atlantic Wolffish	176	196	483	552	945	2,006
4X Monkfish	308	486	732	705	1,190	2,288
4VW Monkfish	760	738	1,178	1,027	1,347	3,281
4X Smooth Skate	326	106	344	400	369	490
4VW Smooth Skate	49	240	119	175	198	474
4X Thorny Skate	323	166	232	671	1,080	4,044
4VW Thorny Skate	1,421	1,602	4,591	3,235	4,505	11,690
4X Barndoor Skate	985	1,235	367	1,809	974	426
4VW Barndoor Skate	1,169	564	671	355	228	235
4X Winter Skate	998	1,784	729	792	822	981
4VW Winter Skate	277	97	408	427	1,001	3,650
4X Little Skate	1,467	1,272	855	968	991	780
4VW Little Skate	262	67	143	78	105	136
4VWX Spiny Dogfish	259,461	44,310	23,253	116,581	168,785	126,363
4X Longhorn Sculpin	803	784	1,963	2,155	1,840	1,620
4VW Longhorn Sculpin	1,637	1,044	1,300	2,190	3,178	2,904

*For silver hake, average is 1982-2011.

Atlantic Cod

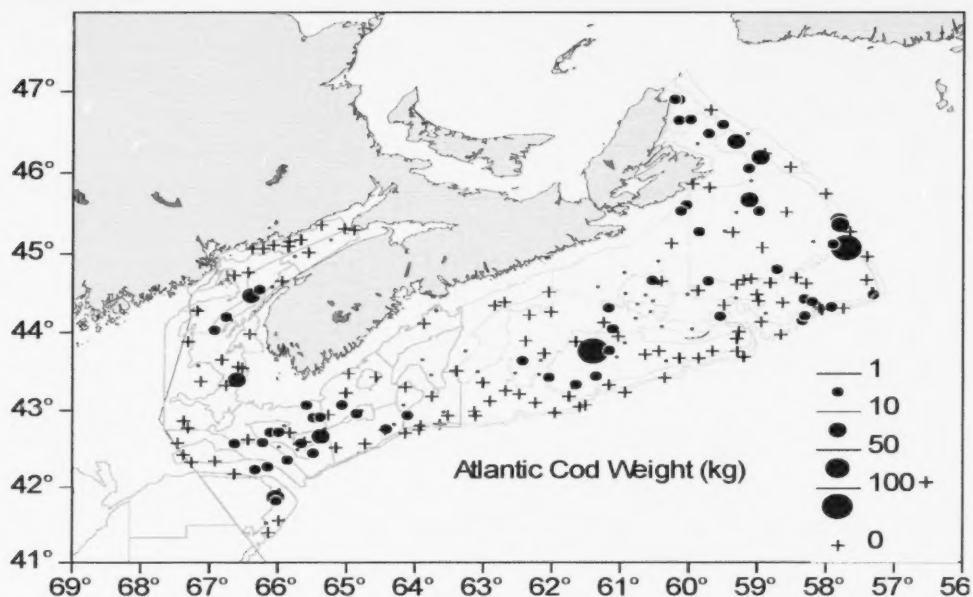


Figure 3a. Distribution of Atlantic Cod catches during the 2013 summer RV survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

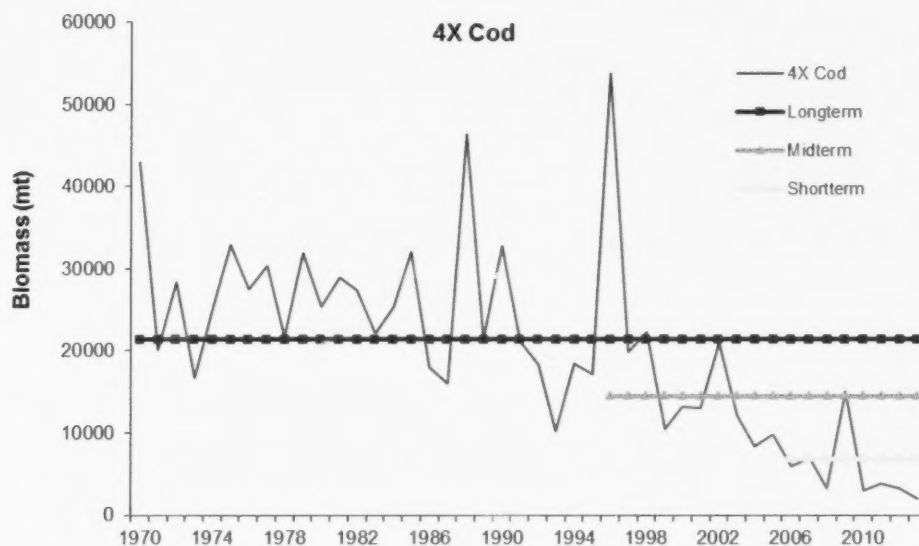


Figure 3b. Biomass index for Atlantic Cod in 4X from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

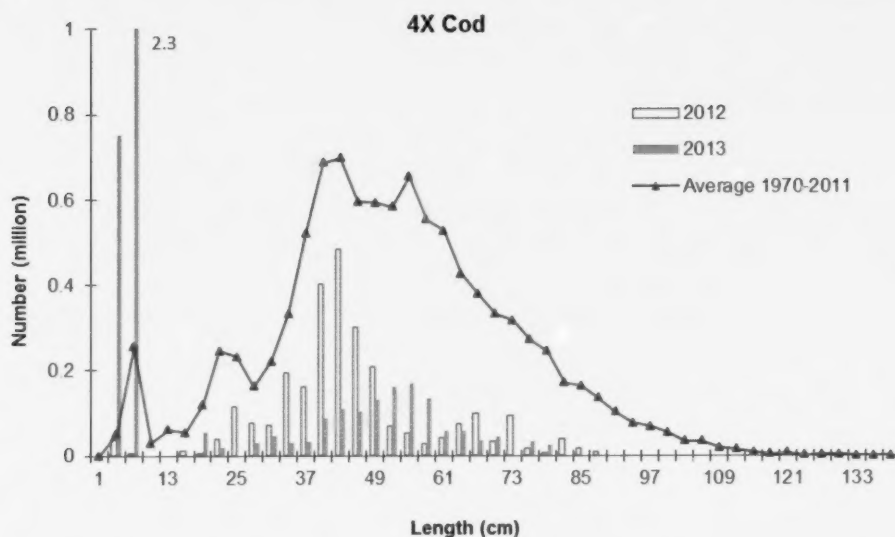


Figure 3c. Length frequency indices for Atlantic Cod in 4X from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

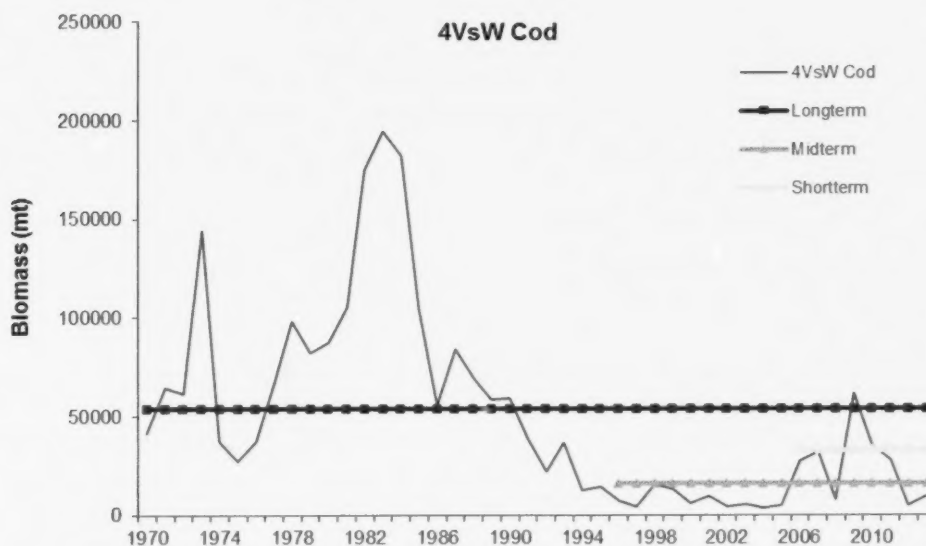


Figure 3d. Biomass index for Atlantic Cod in 4VsW from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

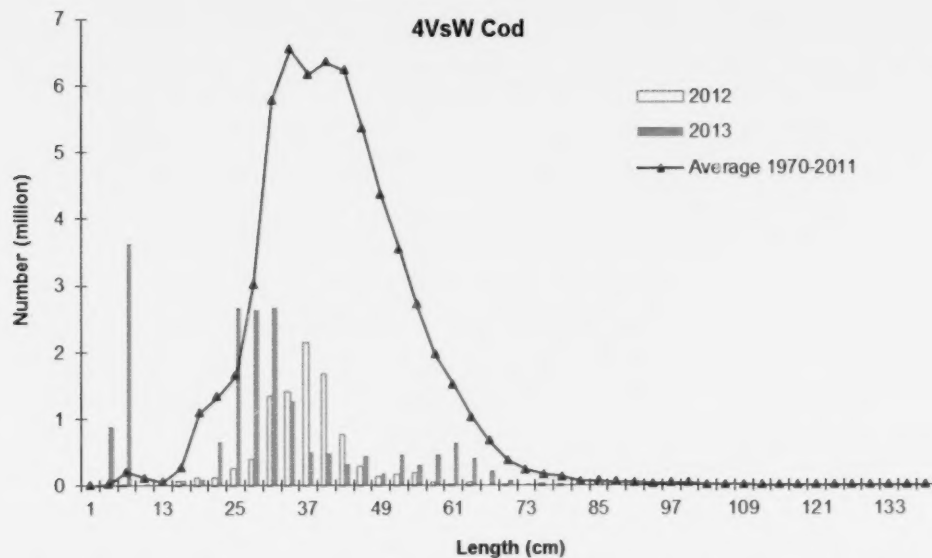


Figure 3e. Length frequency indices for Atlantic Cod in 4VsW from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

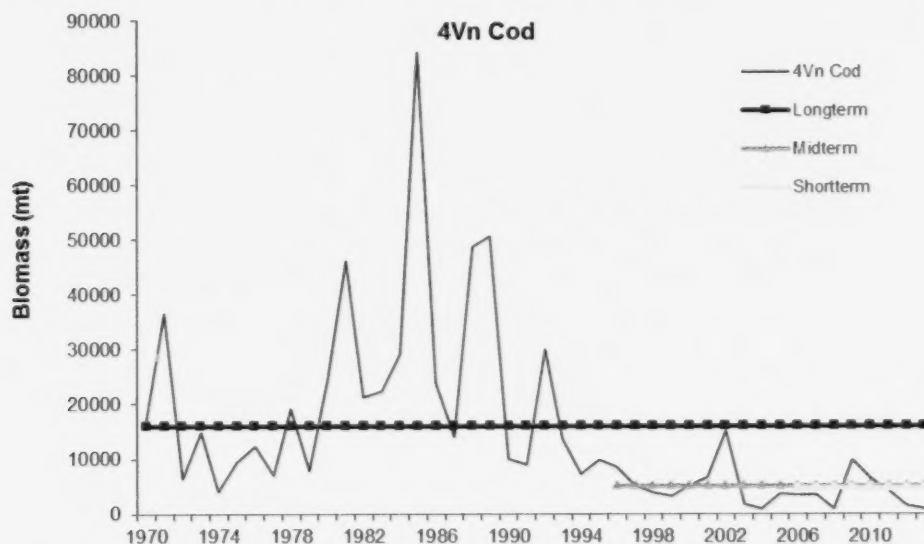


Figure 3f. Biomass index for Atlantic Cod in 4Vn from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

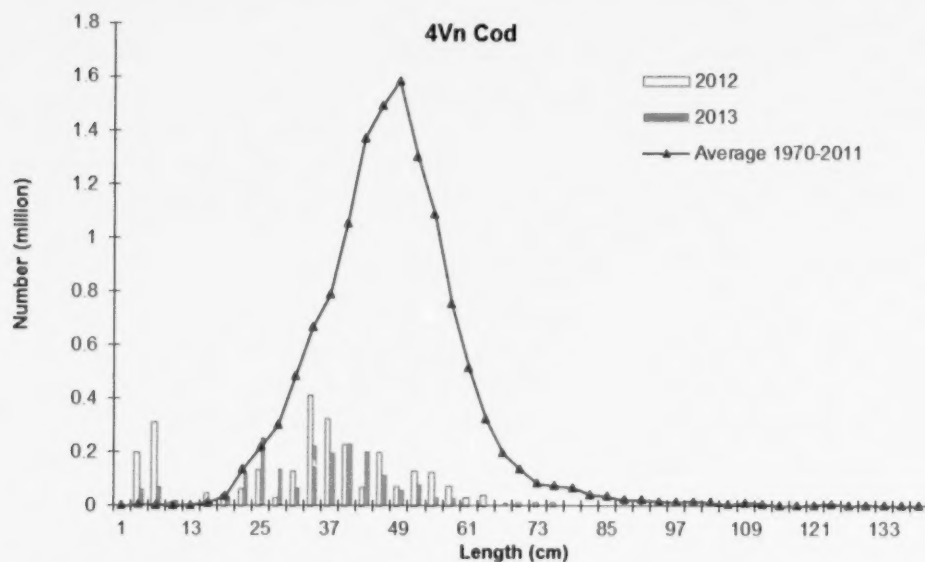


Figure 3g. Length frequency indices for Atlantic Cod in 4Vn from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

Haddock

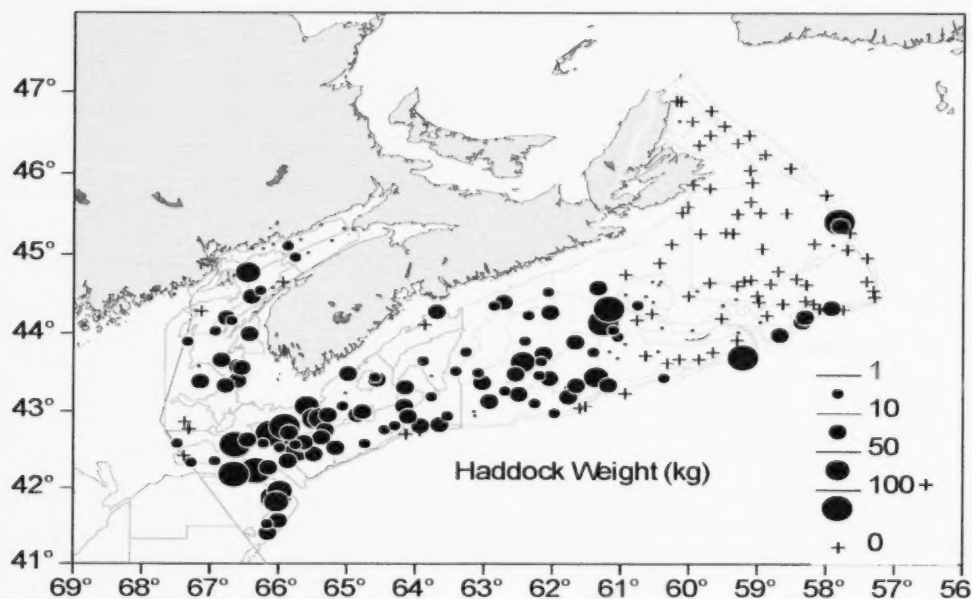


Figure 4a. Distribution of Haddock catches during the 2013 summer RV survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

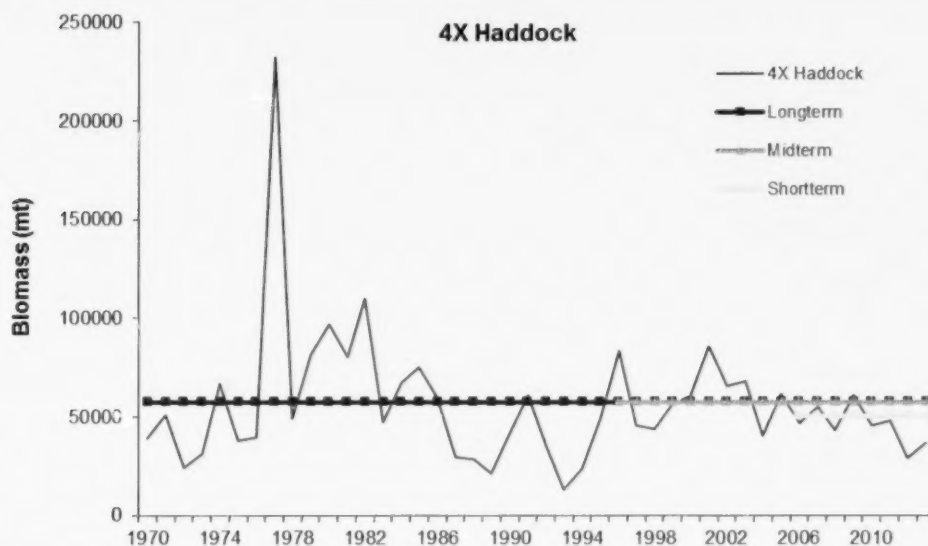


Figure 4b. Biomass index for Haddock in 4X from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

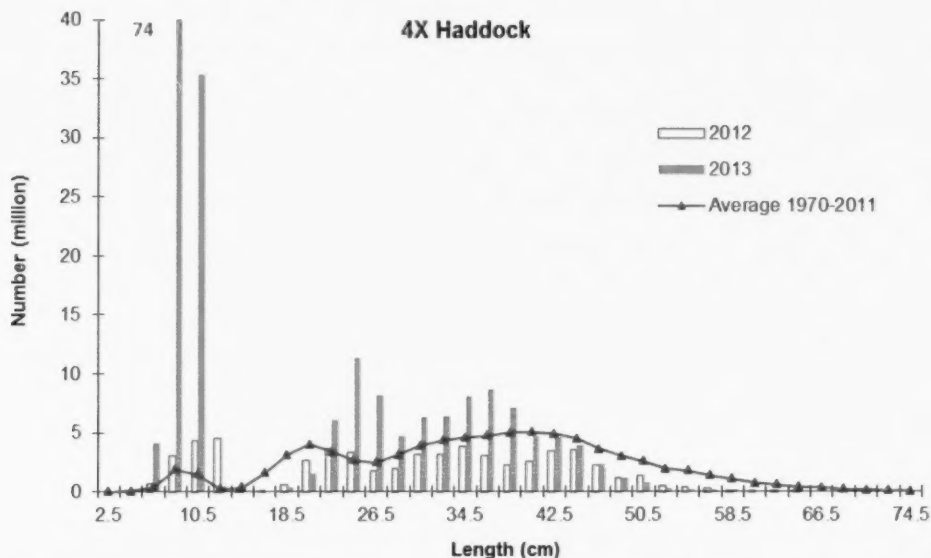


Figure 4c. Length frequency indices for Haddock in 4X from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

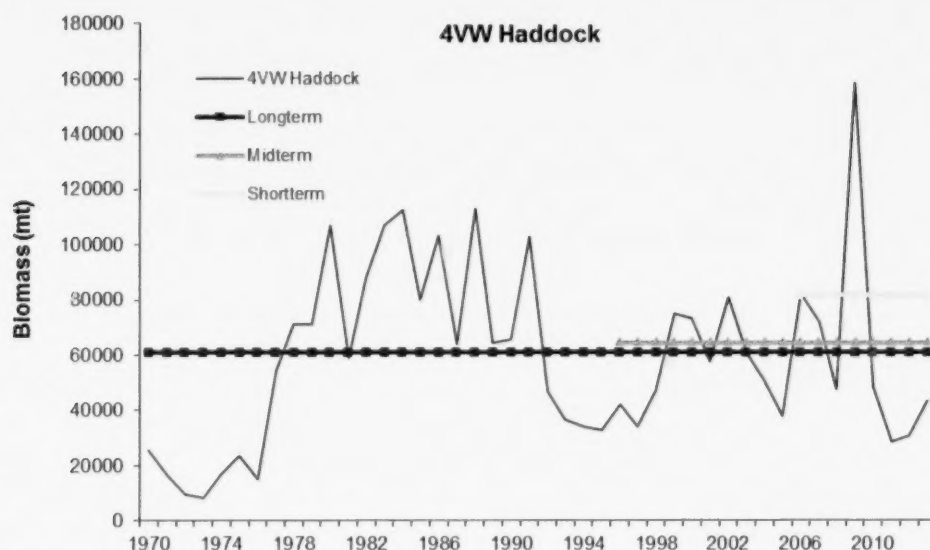


Figure 4d. Biomass index for Haddock in 4VW from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

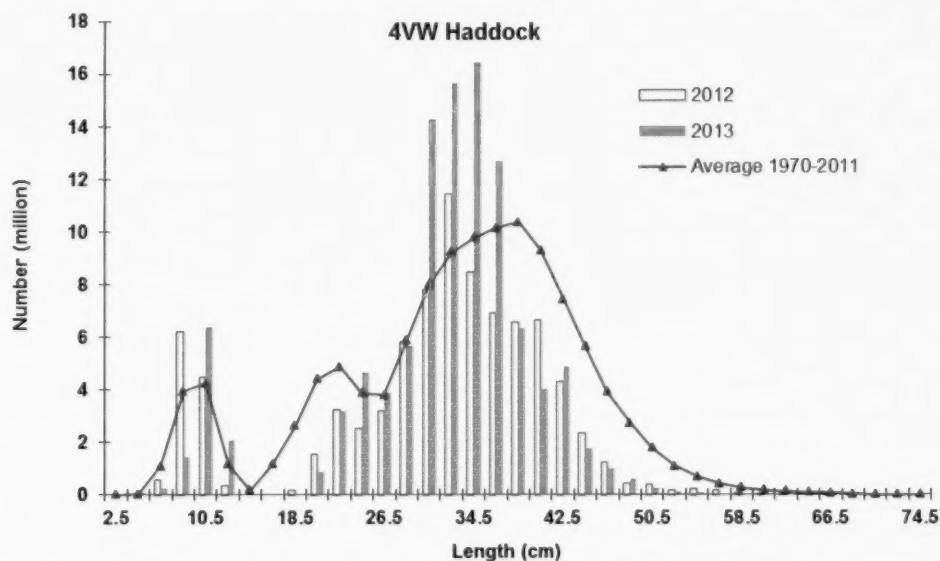


Figure 4e. Length frequency indices for Haddock in 4VW from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

White Hake

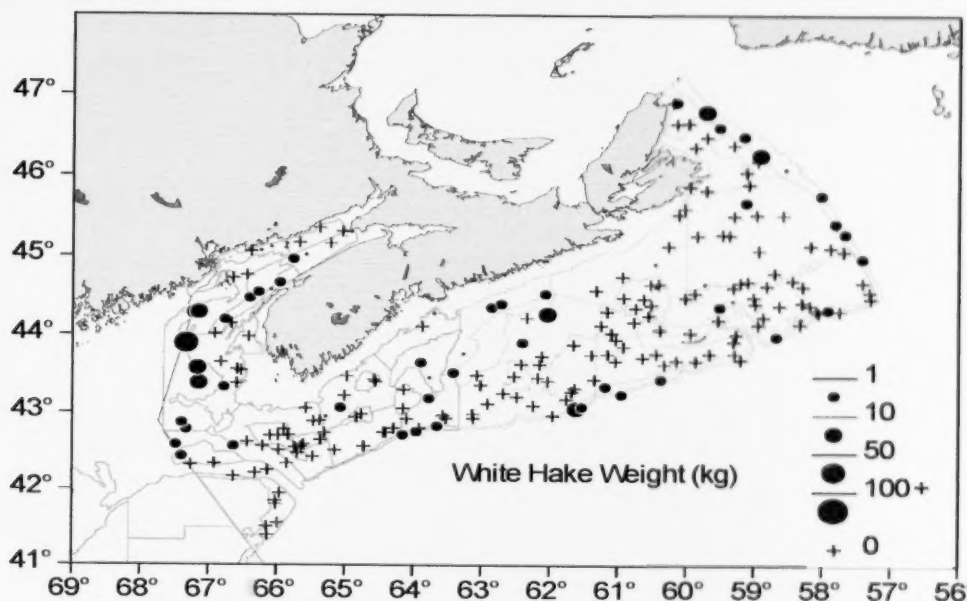


Figure 5a. Distribution of White Hake catches during the 2013 summer RV survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

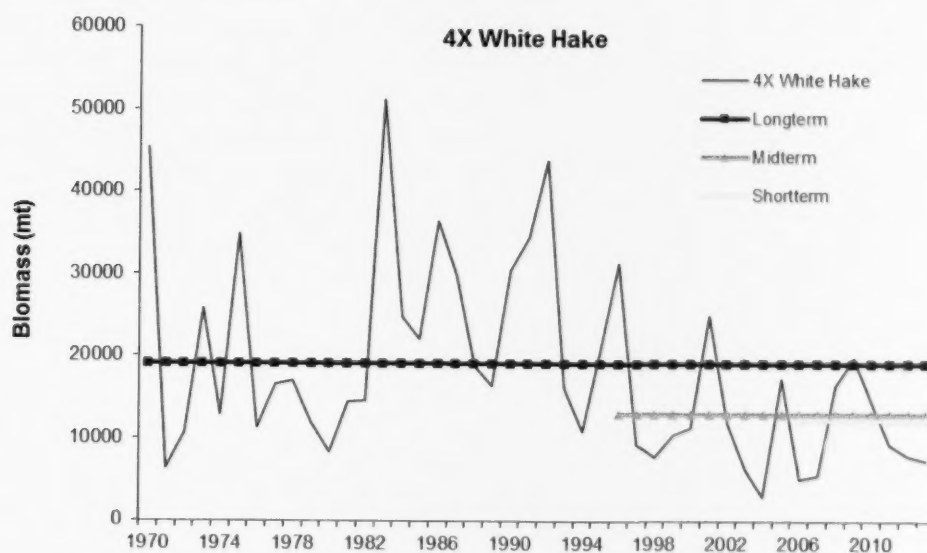


Figure 5b. Biomass index for White Hake in 4X from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1982-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

White Hake 4X

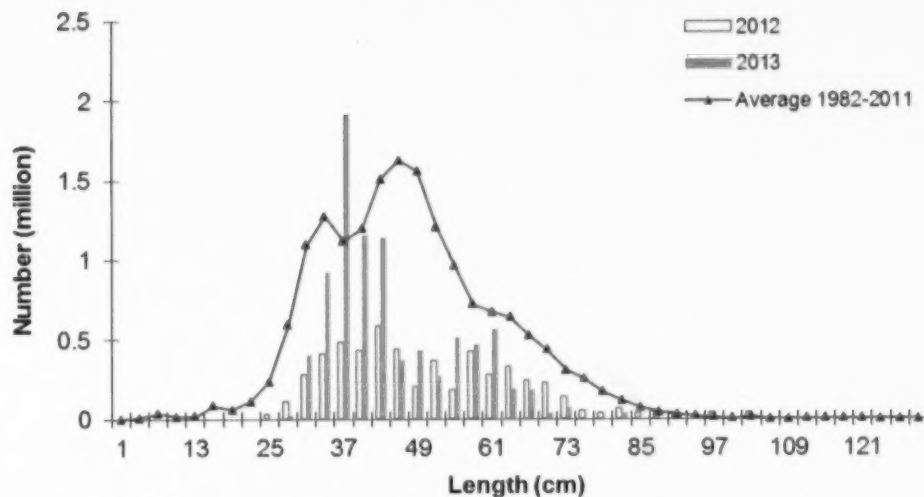


Figure 5c. Length frequency indices for White Hake in 4X from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

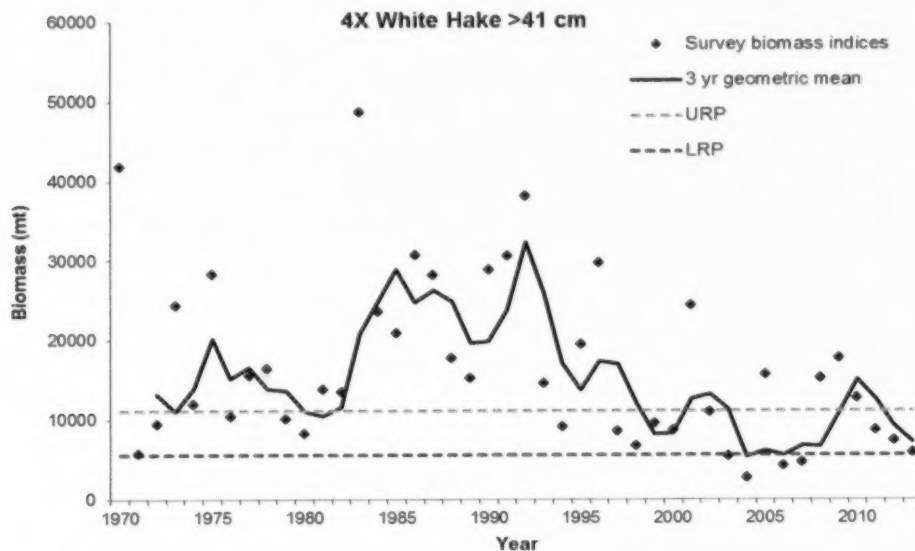


Figure 5d. Biomass index for 4X White Hake >41 cm from the summer RV survey represented by the dark blue diamonds. The solid black line represents the 3 year geometric mean. The dashed blue line represents the lower limit reference point and the dashed green line represents the upper limit reference point.

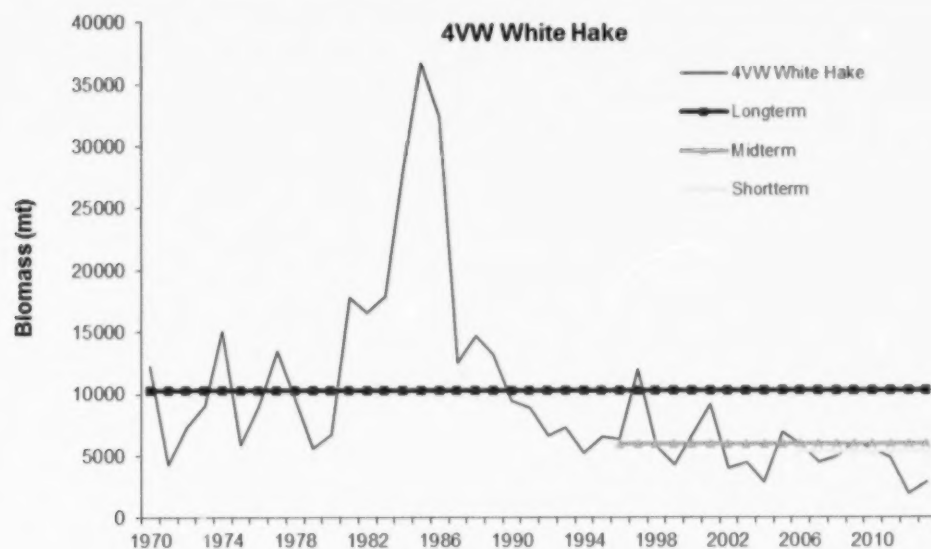


Figure 5e. Biomass index for White Hake in 4VW from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1982-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

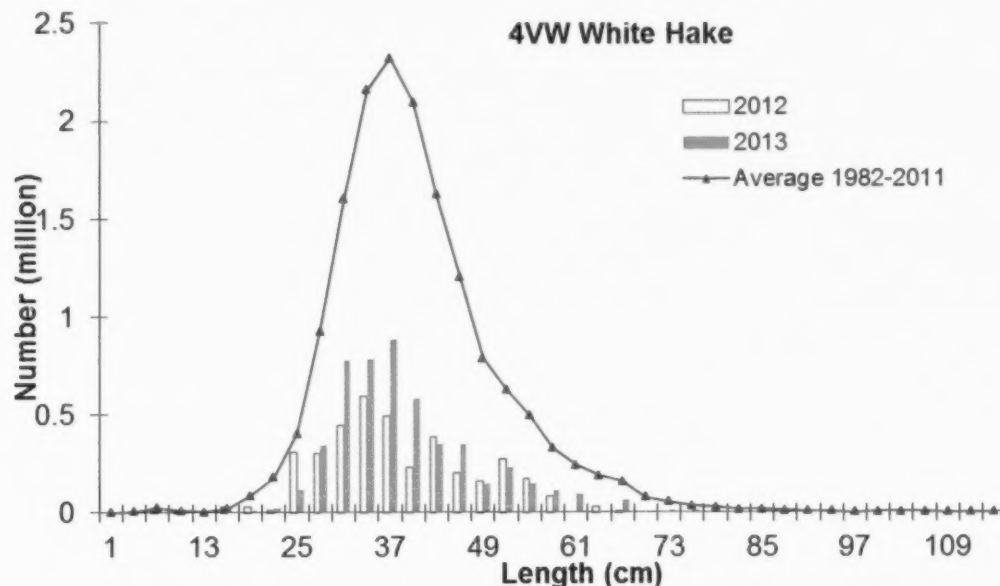


Figure 5f. Length frequency indices for White Hake in 4VW from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

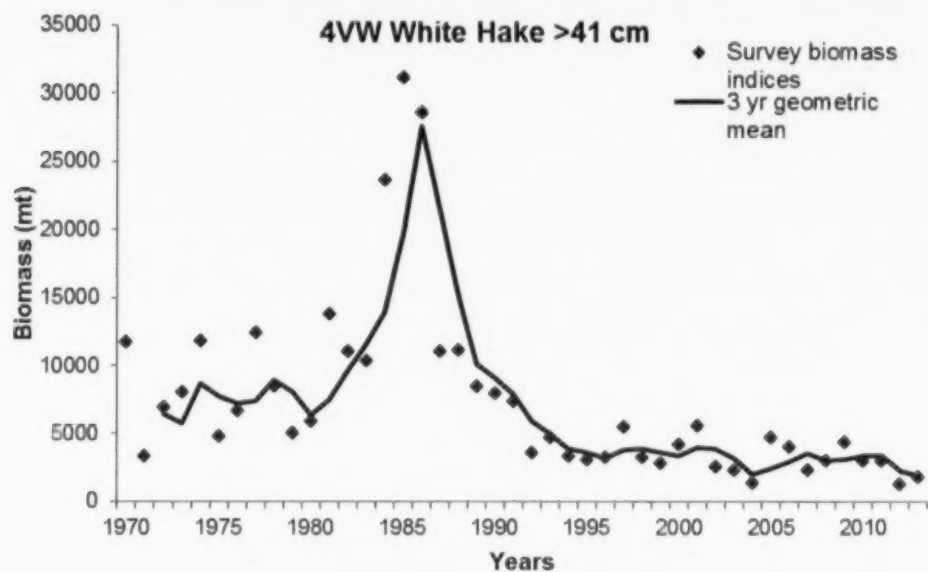


Figure 5g. Biomass index for 4VW White Hake >41 cm from the summer RV survey represented by the dark blue diamonds. The solid black line represents the 3 year geometric mean.

Silver Hake

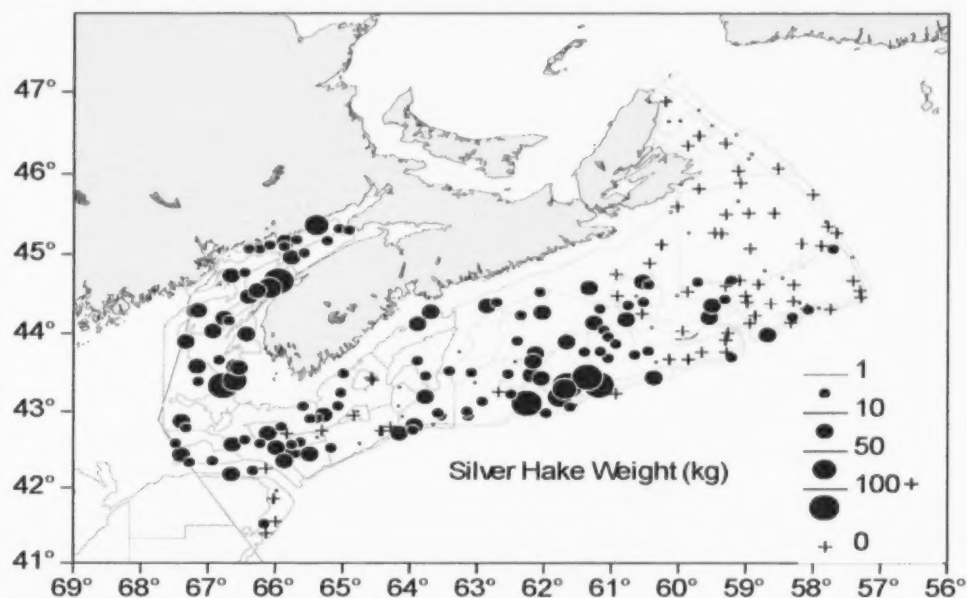


Figure 6a. Distribution of Silver Hake catches during the 2013 summer RV survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

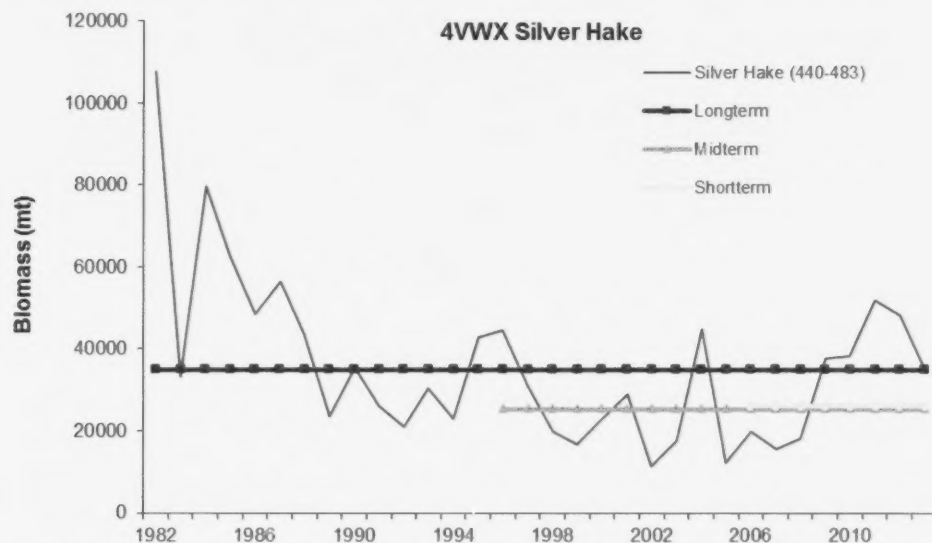


Figure 6b. Biomass index for Silver Hake in 4VWX from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1982-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

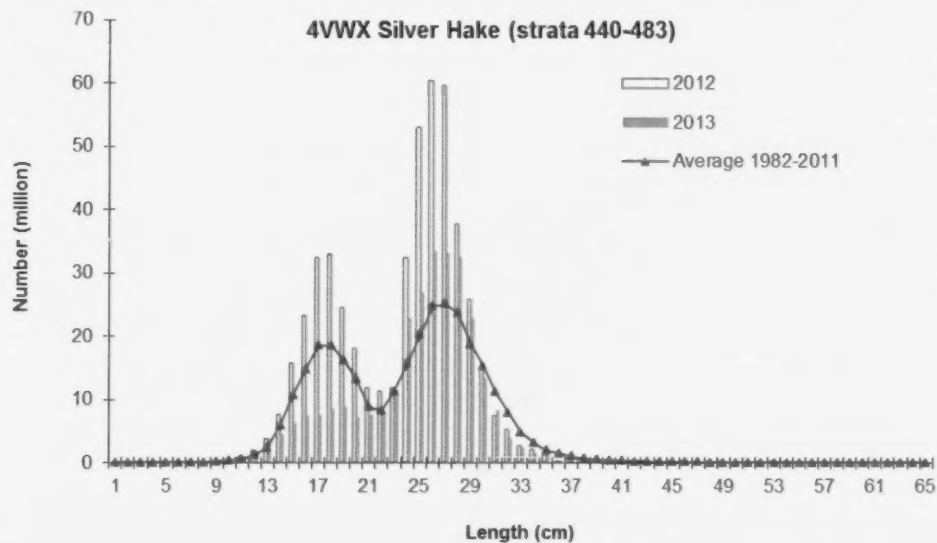


Figure 6c. Length frequency indices for Silver Hake in 4VWX from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1982-2011.

Pollock

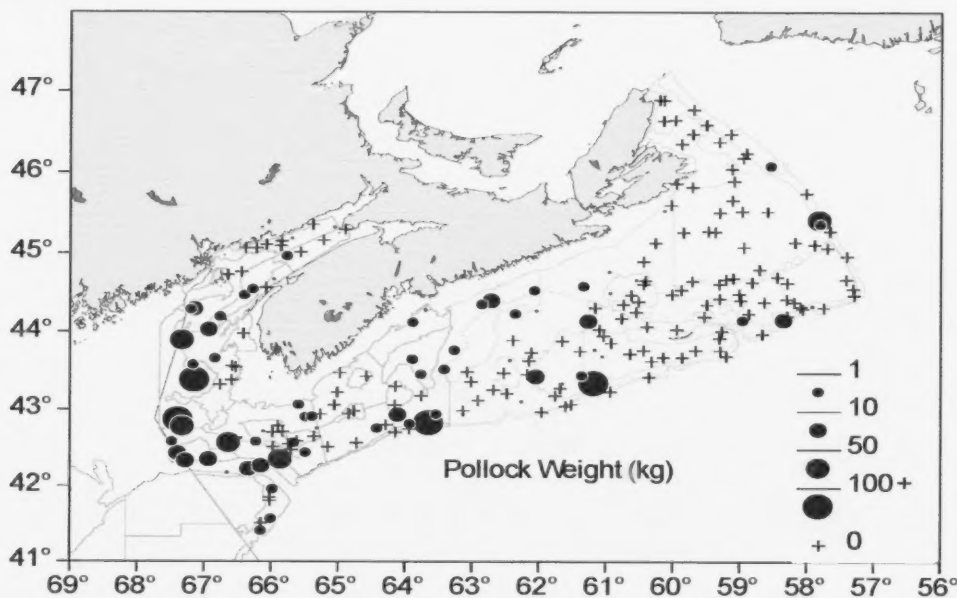


Figure 7a. Distribution of Pollock catches during the 2013 summer RV survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

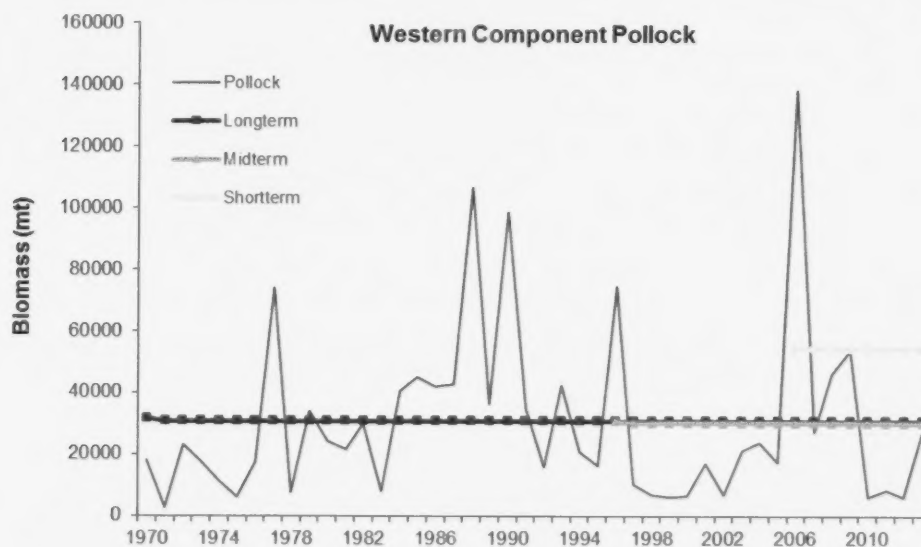


Figure 7b. Biomass index for Western Component Pollock from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

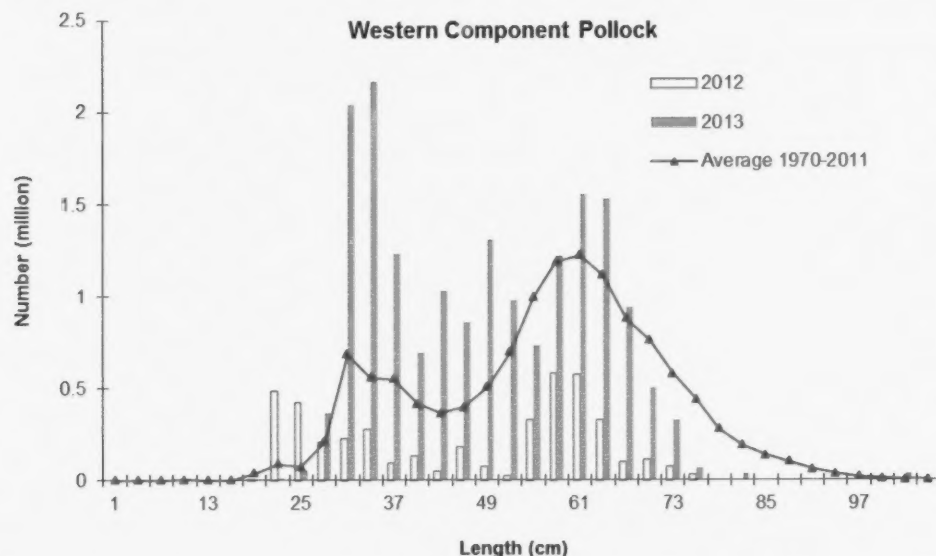


Figure 7c. Length frequency indices for Western Component Pollock from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

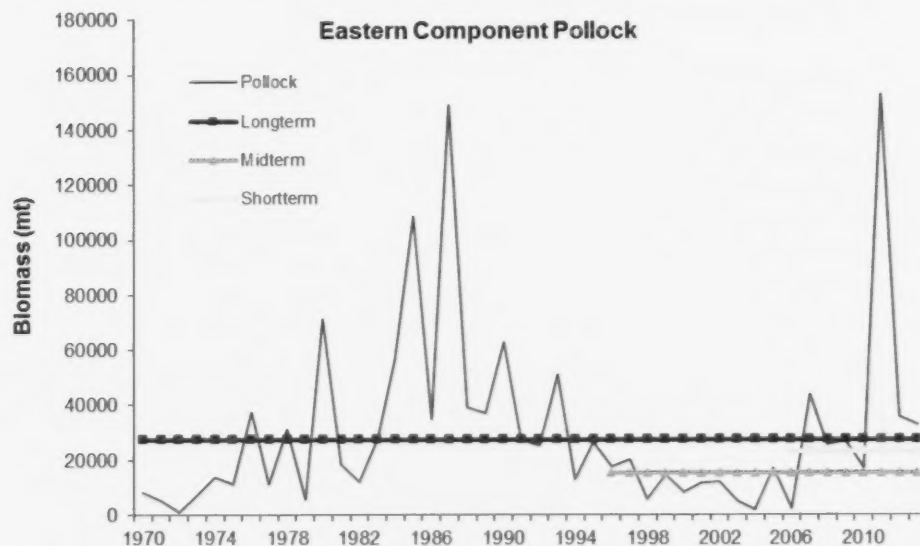


Figure 7d. Biomass index for Eastern Component Pollock from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

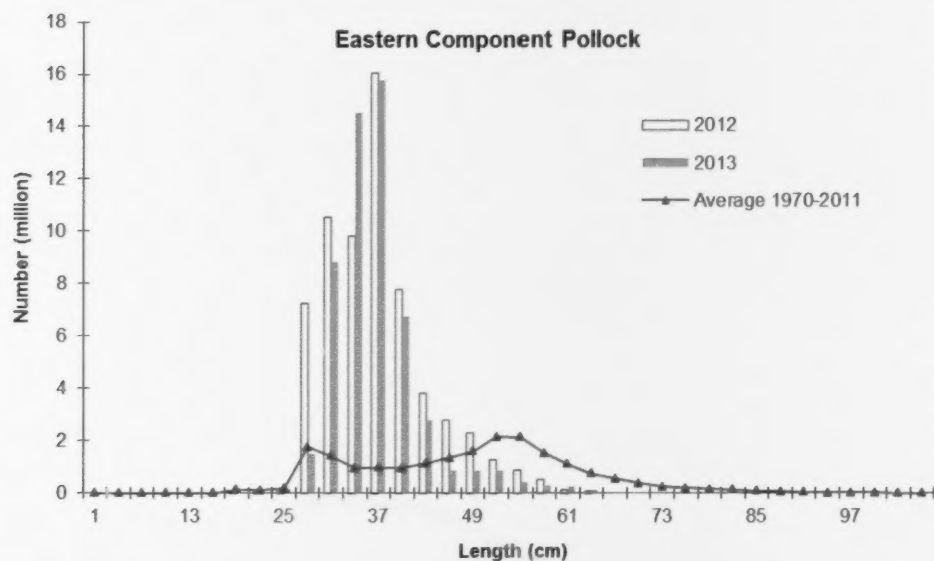


Figure 7e. Length frequency indices for Eastern Component Pollock from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

Redfish

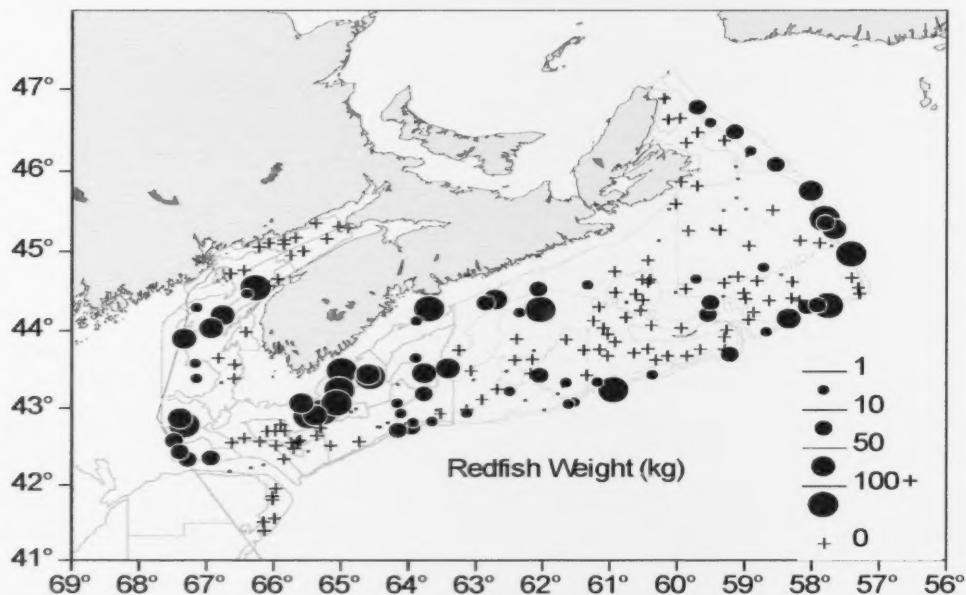


Figure 8a. Distribution of Redfish catches during the 2013 summer RV survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

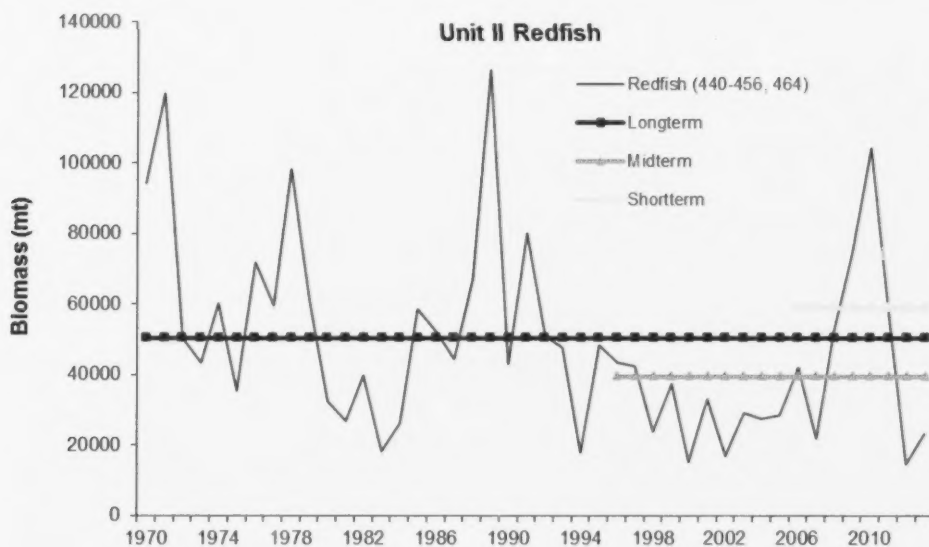


Figure 8b. Biomass index for Unit II Redfish from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

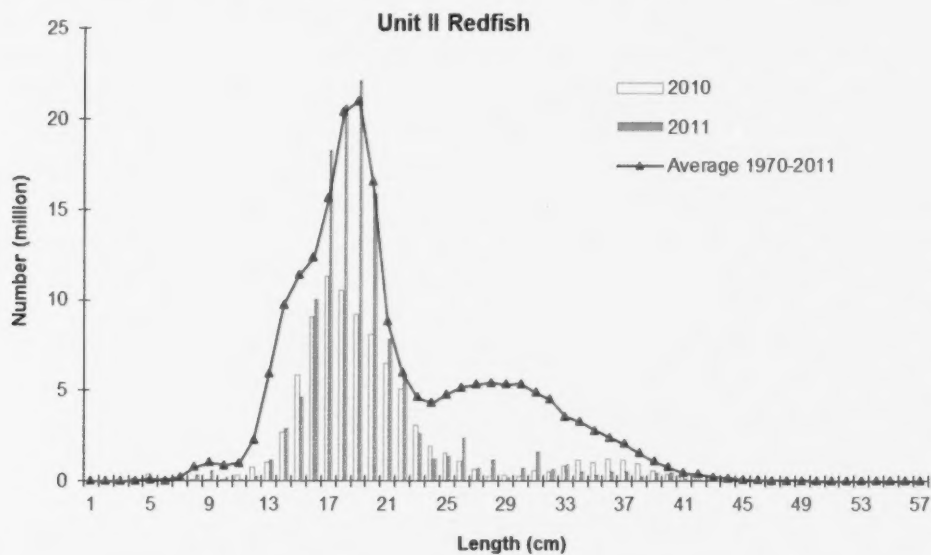


Figure 8c. Length frequency indices for Unit II Redfish from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

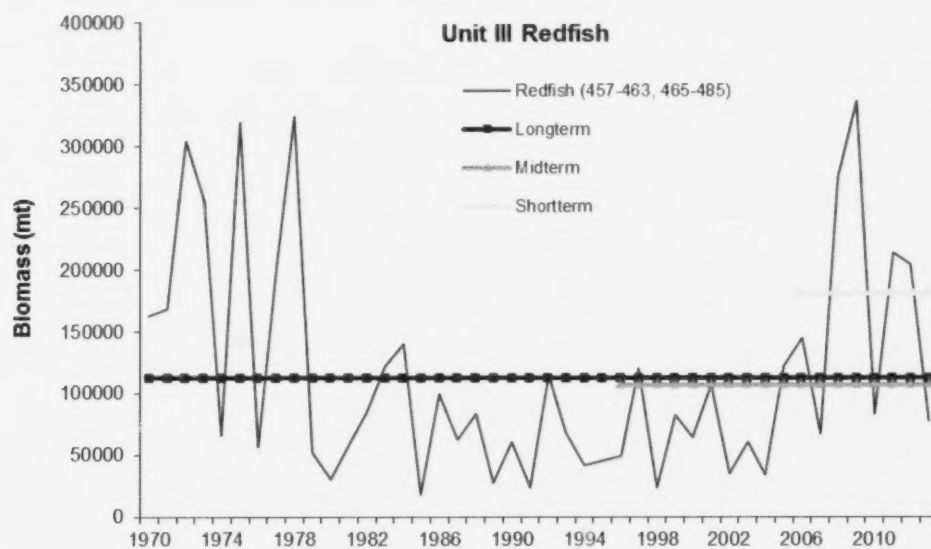


Figure 8d. Biomass index for Unit III Redfish from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

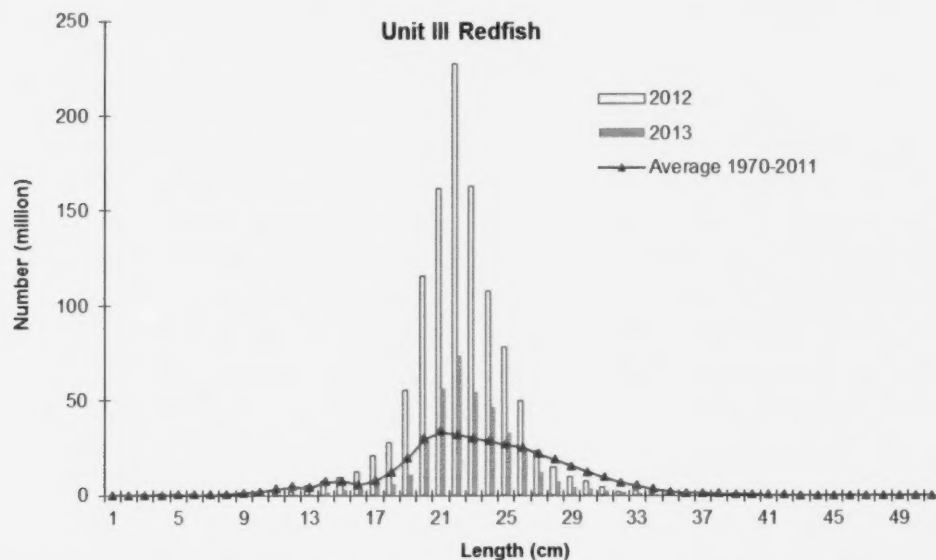


Figure 8e. Length frequency indices for Unit III Redfish from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

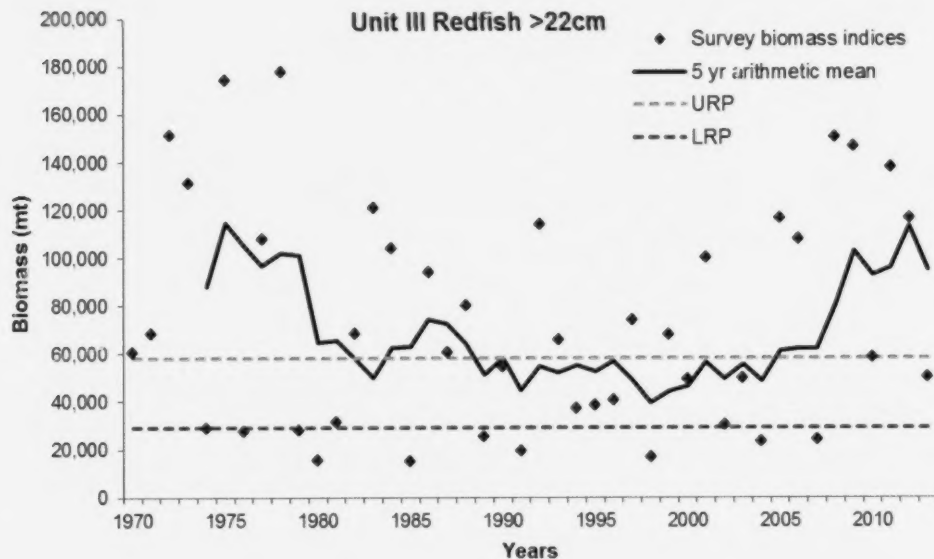


Figure 8f. Biomass index for Unit III Redfish > 22cm from the summer RV survey represented by the dark blue diamonds. The solid black line represents the 5 year arithmetic mean. The dashed blue line represents the lower limit reference point and the dashed green line represents the upper limit reference point.

American Plaice

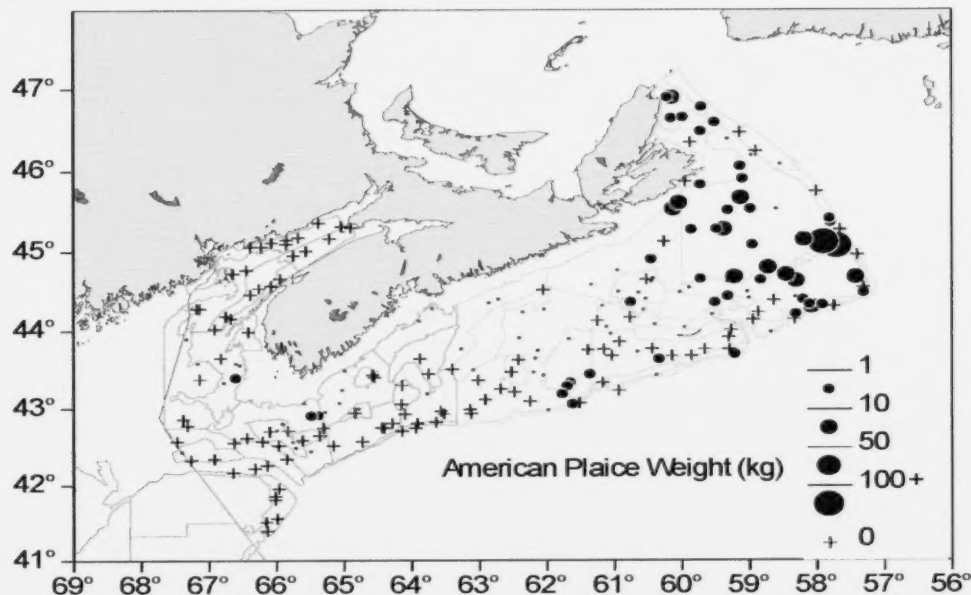


Figure 9a. Distribution of American Plaice catches during the 2013 summer RV survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

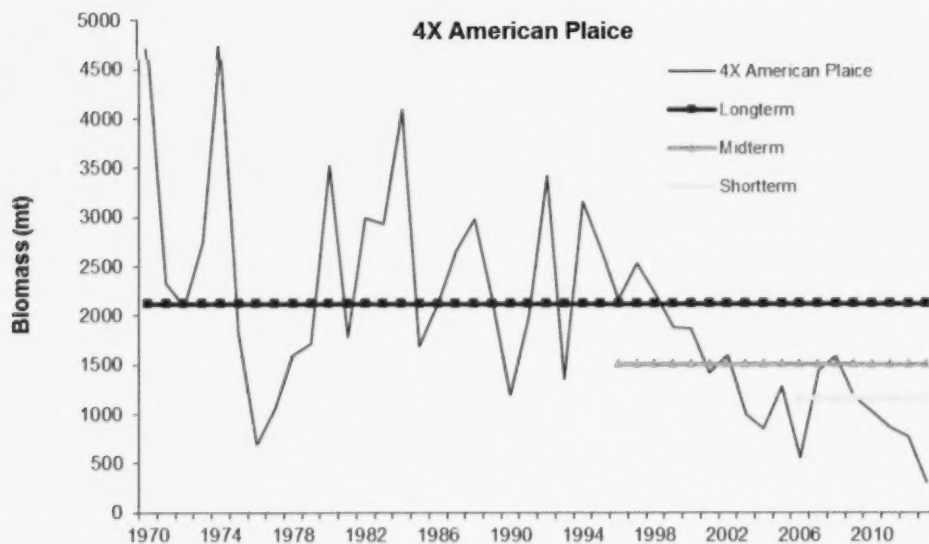


Figure 9b. Biomass index for American Plaice in 4X from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

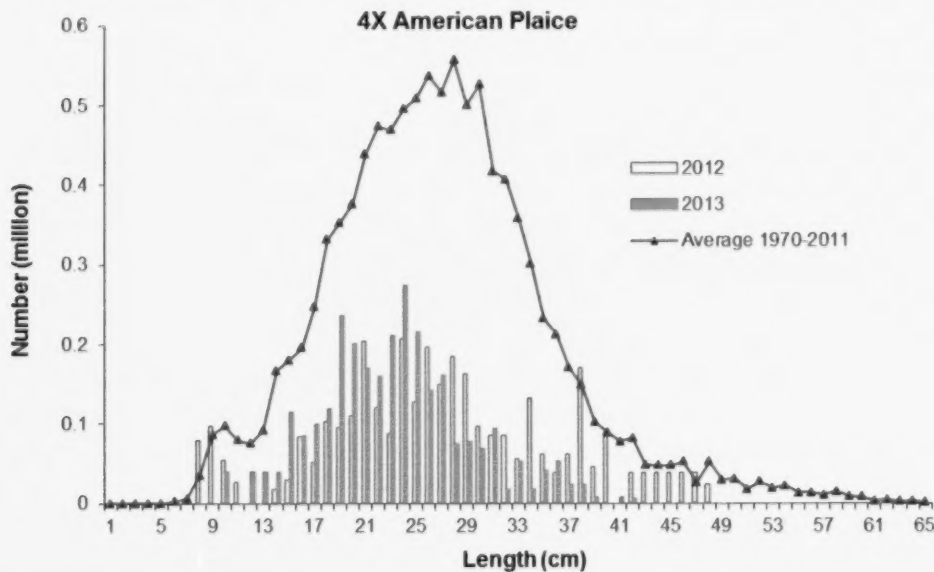


Figure 9c. Length frequency indices for American Plaice in 4X from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

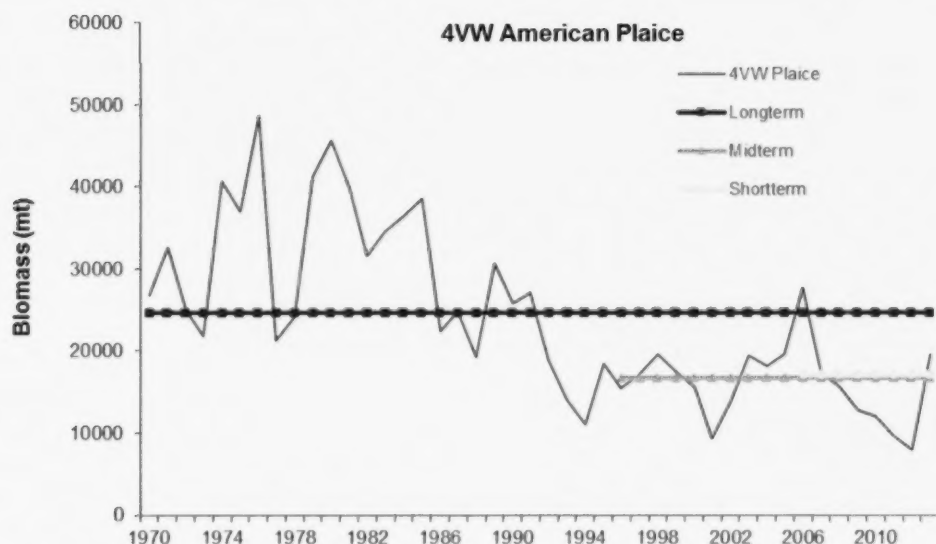


Figure 9d. Biomass index for American Plaice in 4VW from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

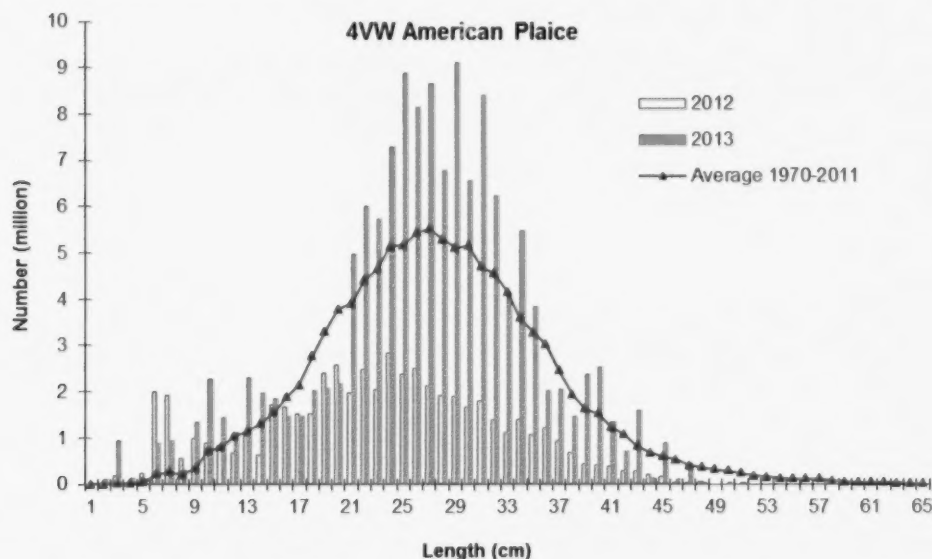


Figure 9e. Length frequency indices for American Plaice in 4VW from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

Witch Flounder

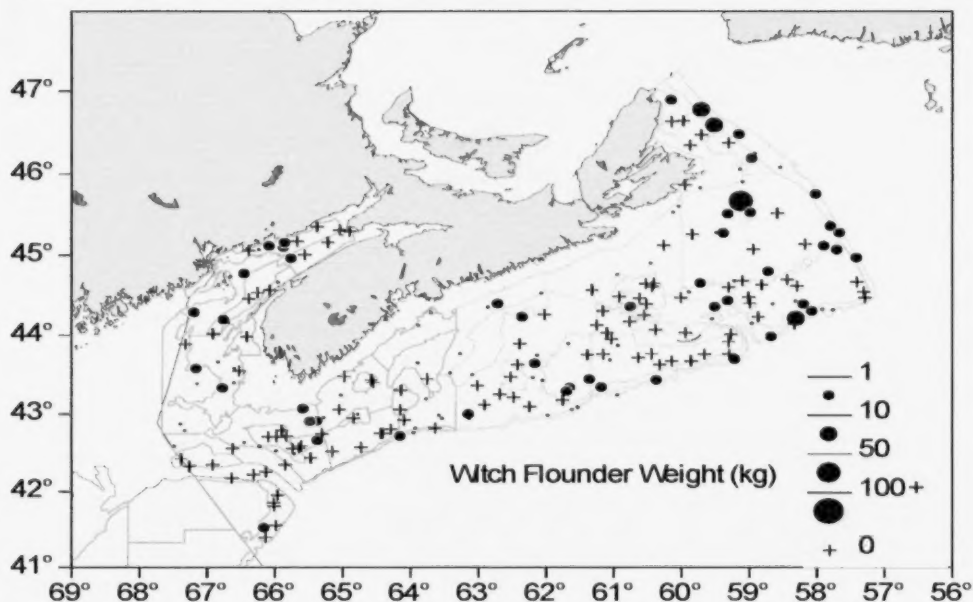


Figure 10a. Distribution of Witch Flounder catches during the 2013 summer RV survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

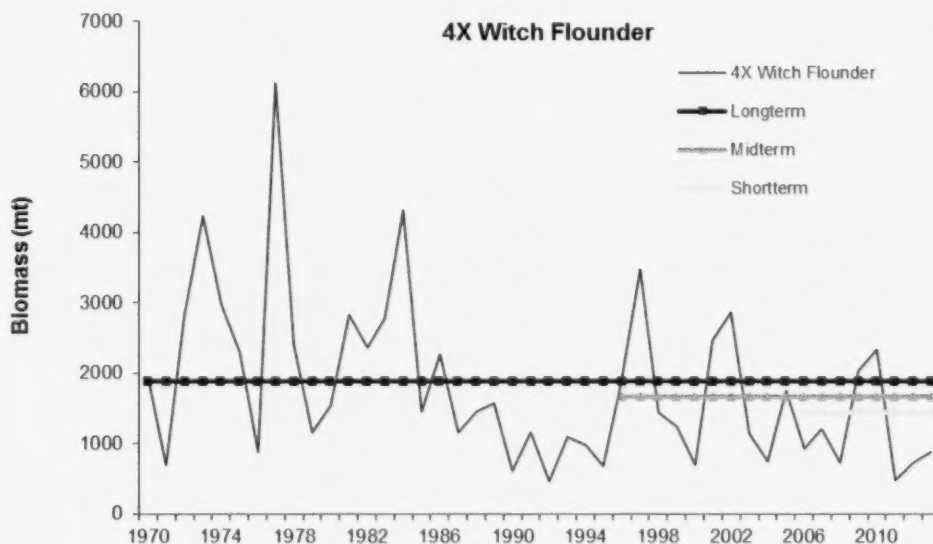


Figure 10b. Biomass index for Witch Flounder in 4X from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

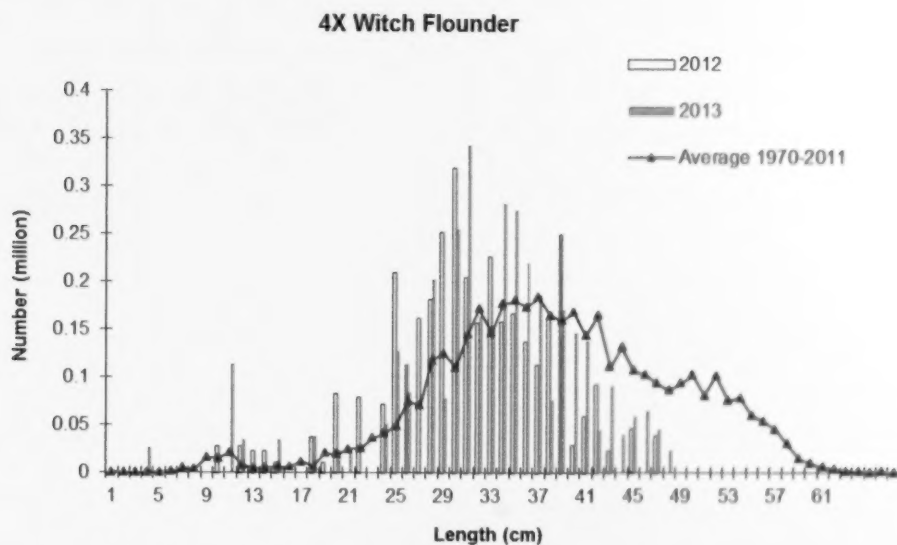


Figure 10c. Length frequency indices for Witch Flounder in 4X from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

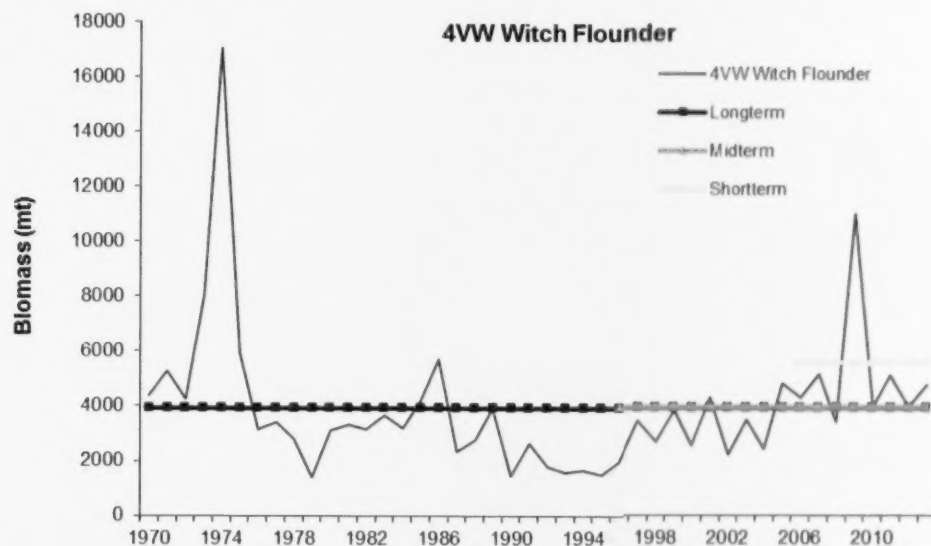


Figure 10d. Biomass index for Witch Flounder in 4VW from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

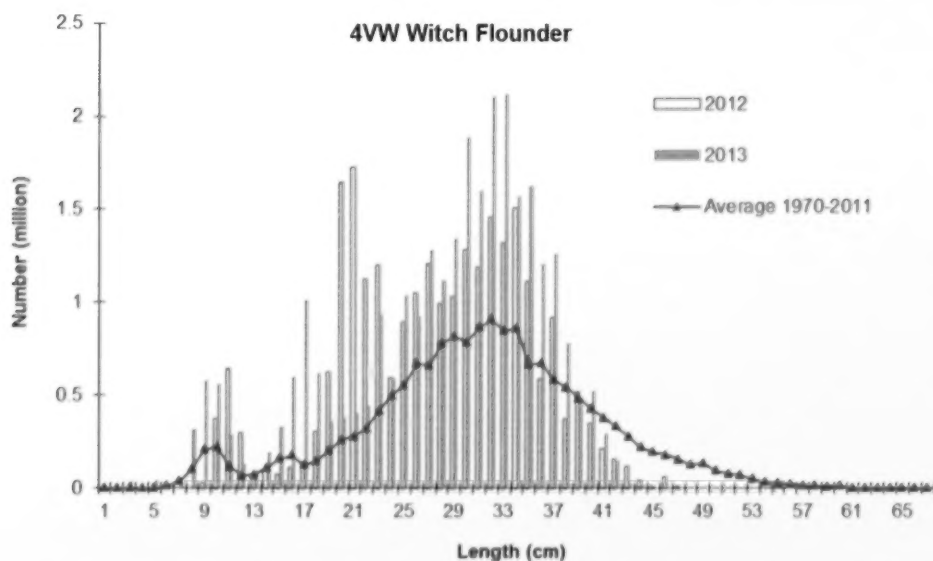


Figure 10e. Length frequency indices for Witch Flounder in 4VW from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

Yellowtail Flounder

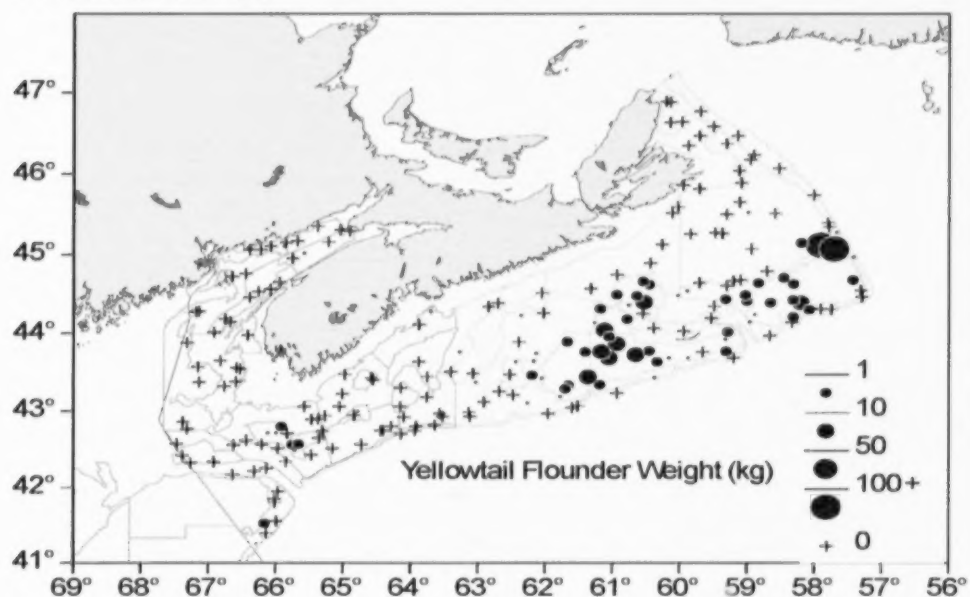


Figure 11a. Distribution of Yellowtail Flounder catches during the 2013 summer RV survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

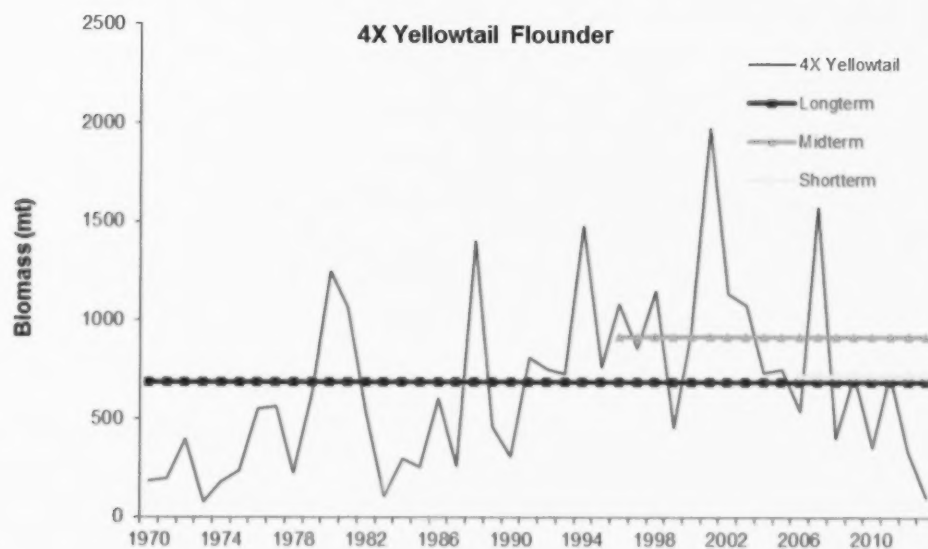


Figure 11b. Biomass index for Yellowtail Flounder in 4X from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

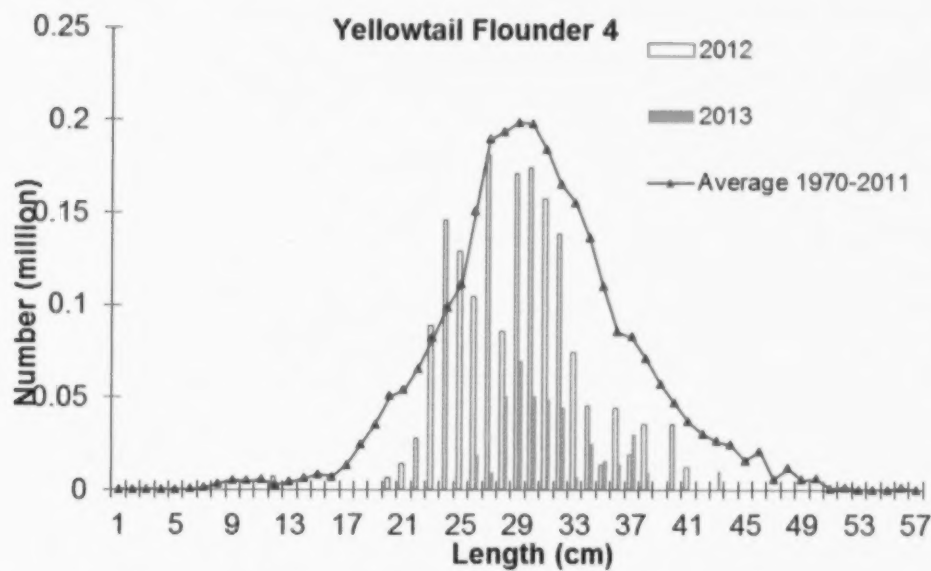


Figure 11c. Length frequency indices for Yellowtail Flounder in 4X from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

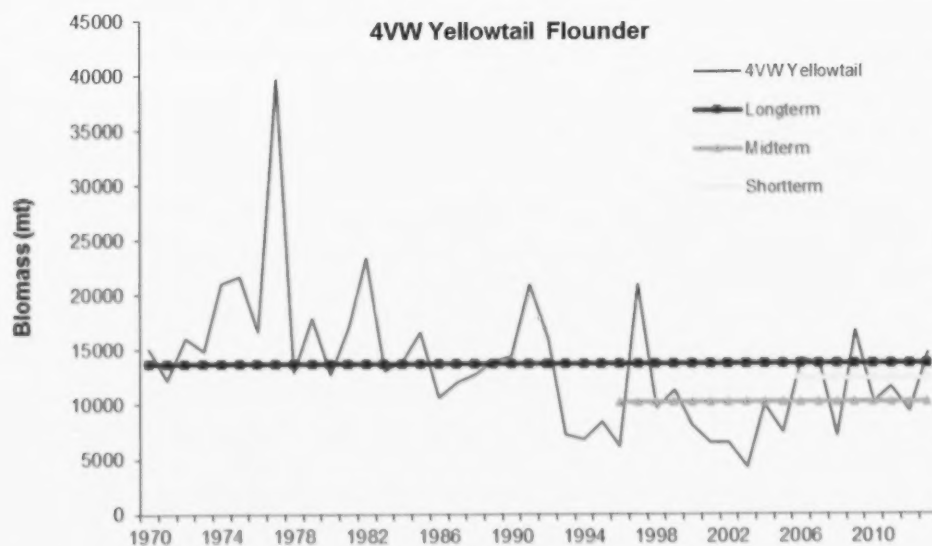


Figure 11d. Biomass index for Yellowtail Flounder in 4VW from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

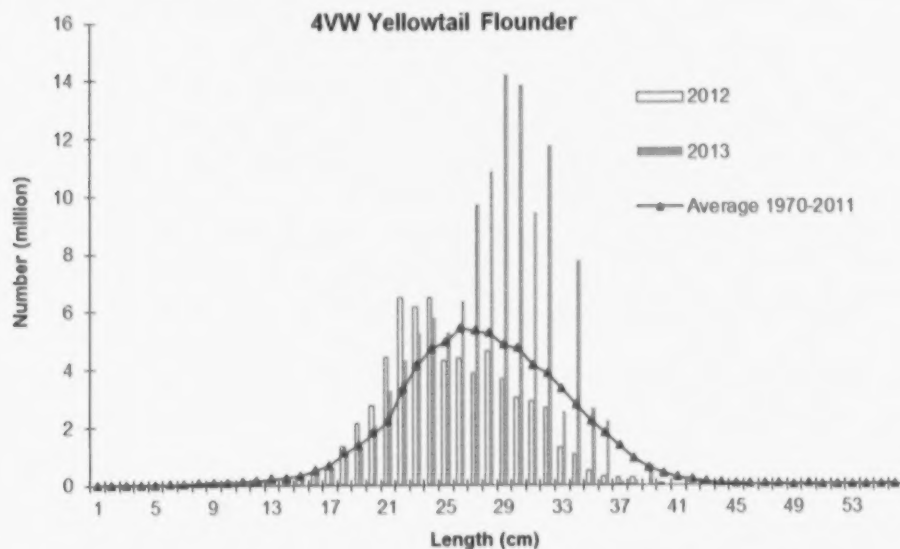


Figure 11e. Length frequency indices for Yellowtail Flounder in 4VW from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

Winter Flounder

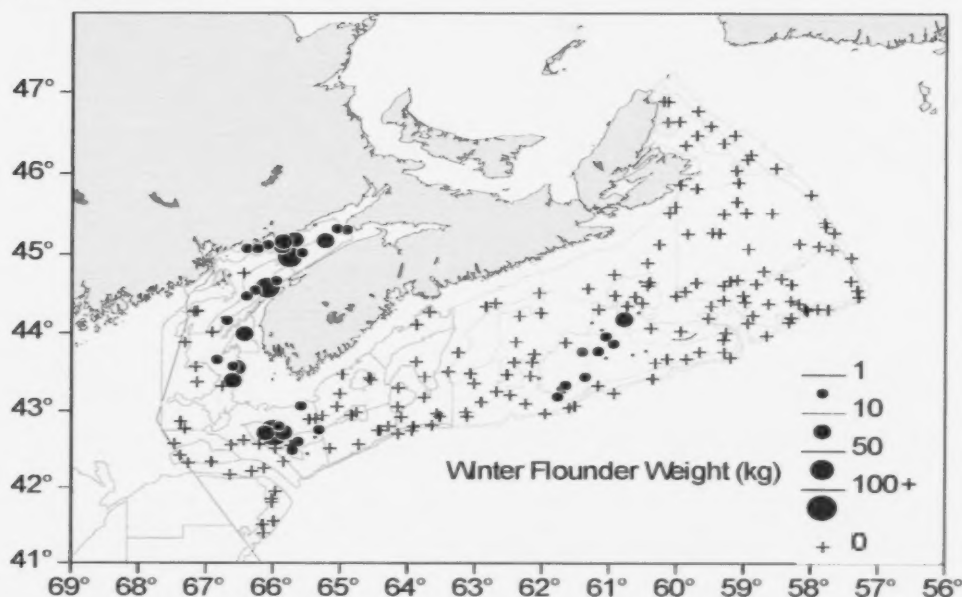


Figure 12a. Distribution of Winter Flounder catches during the 2013 summer RV survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.



Figure 12b. Biomass index for Winter Flounder in 4X from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

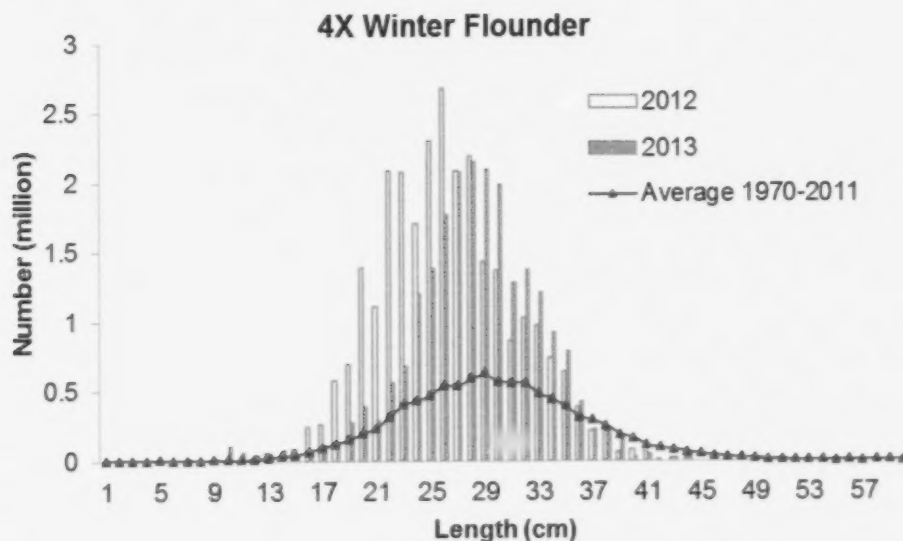


Figure 12c. Length frequency indices for Winter Flounder in 4X from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

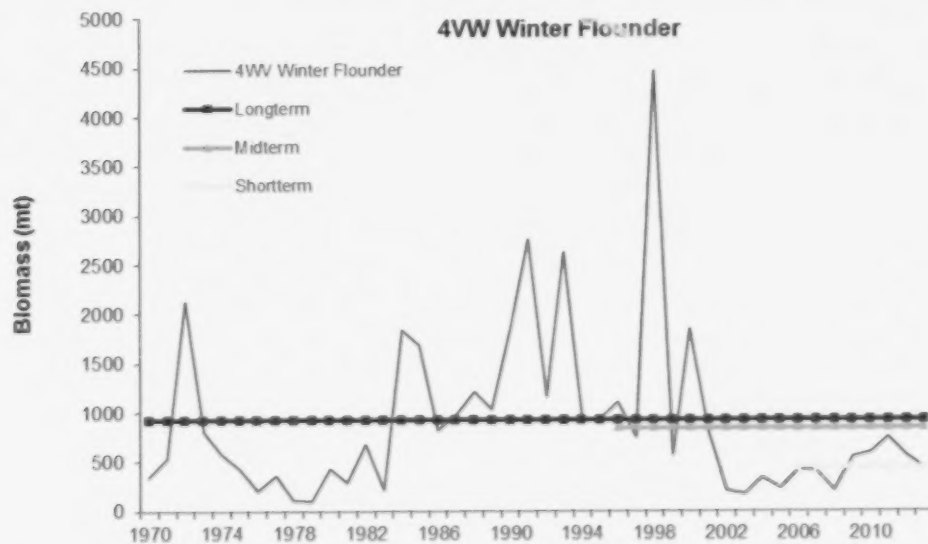


Figure 12d. Biomass index for Winter Flounder in 4VW from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

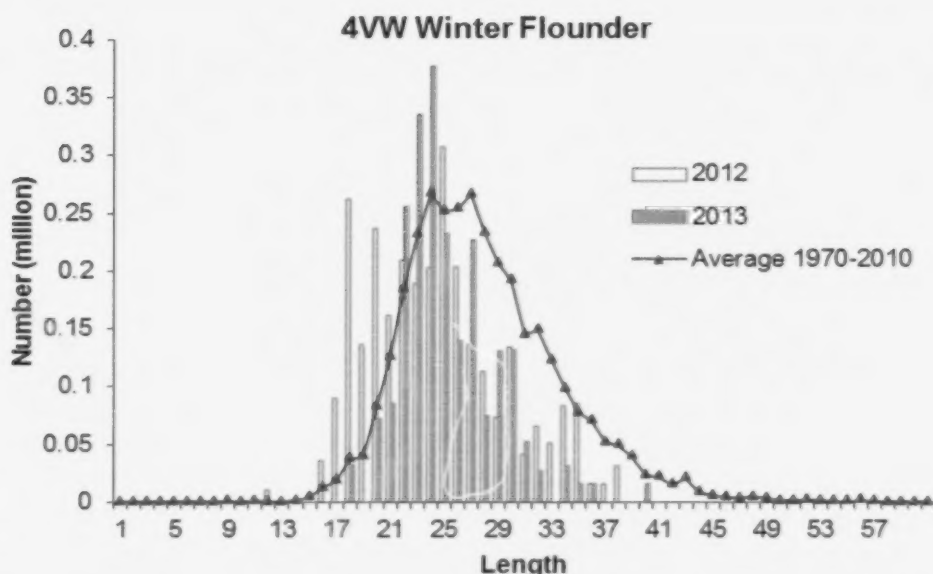


Figure 12e. Length frequency indices for Winter Flounder in 4VW from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

Atlantic Halibut

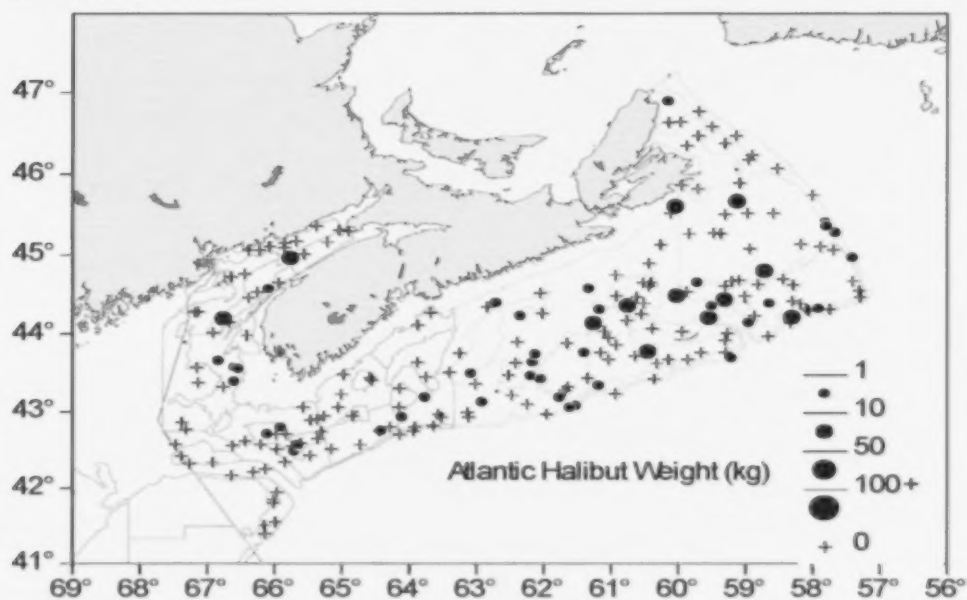


Figure 13a. Distribution of Atlantic Halibut catches during the 2013 summer RV survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

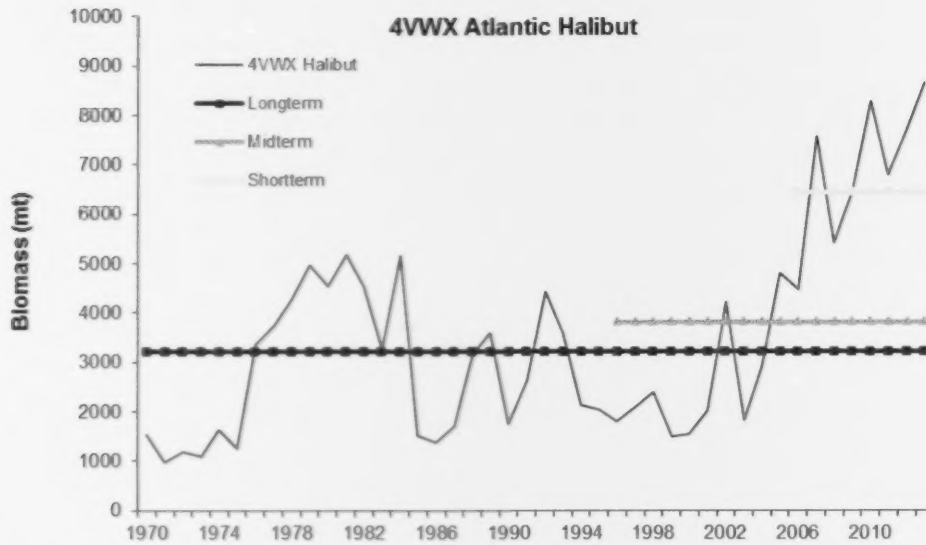


Figure 13b. Biomass index for Atlantic Halibut in 4VWX from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

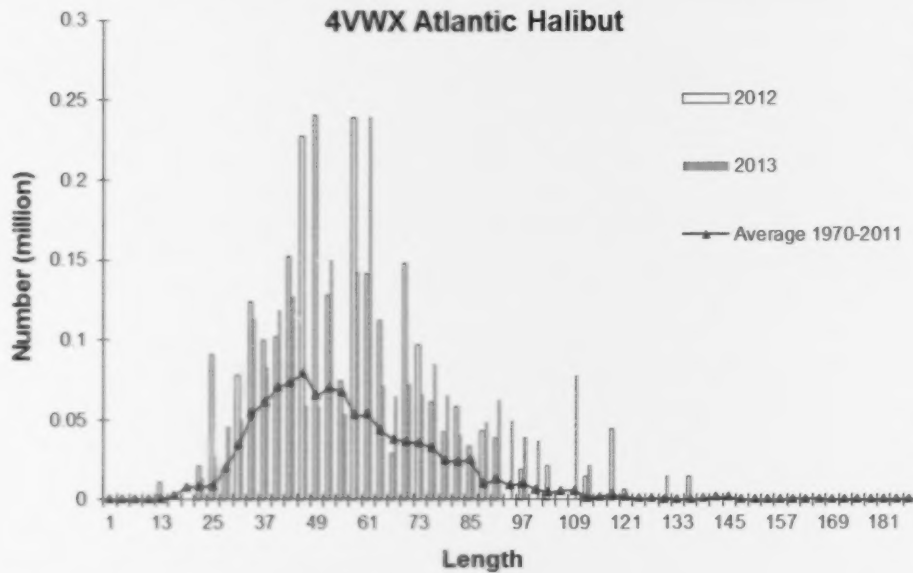


Figure 13c. Length frequency indices for Atlantic Halibut in 4VWX from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

Atlantic Wolffish

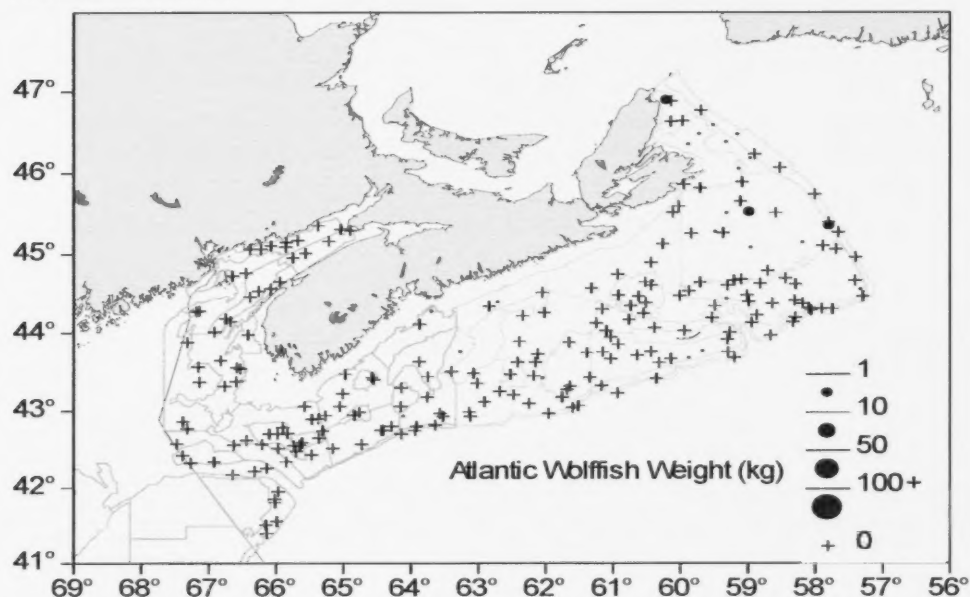


Figure 14a. Distribution of Atlantic Wolffish catches during the 2013 summer RV survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

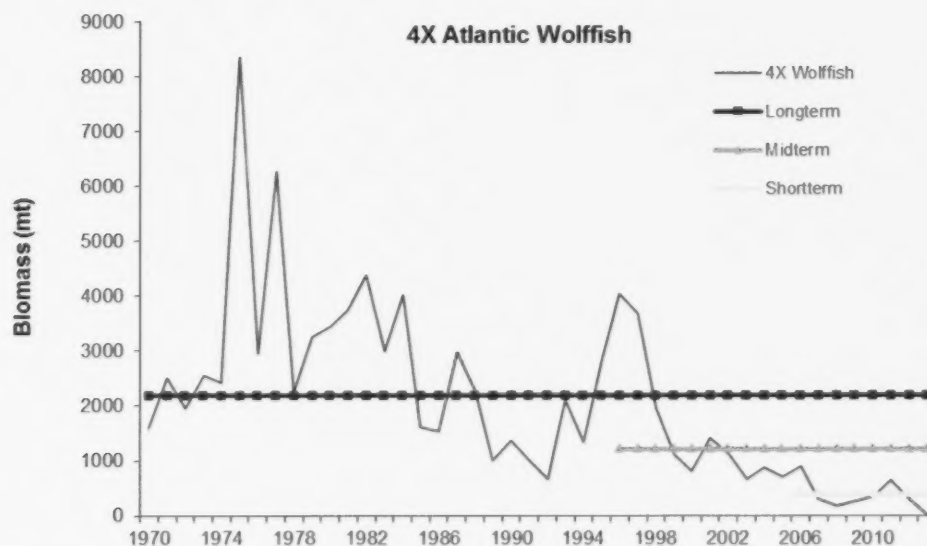


Figure 14b. Biomass index for Atlantic Wolffish in 4X from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

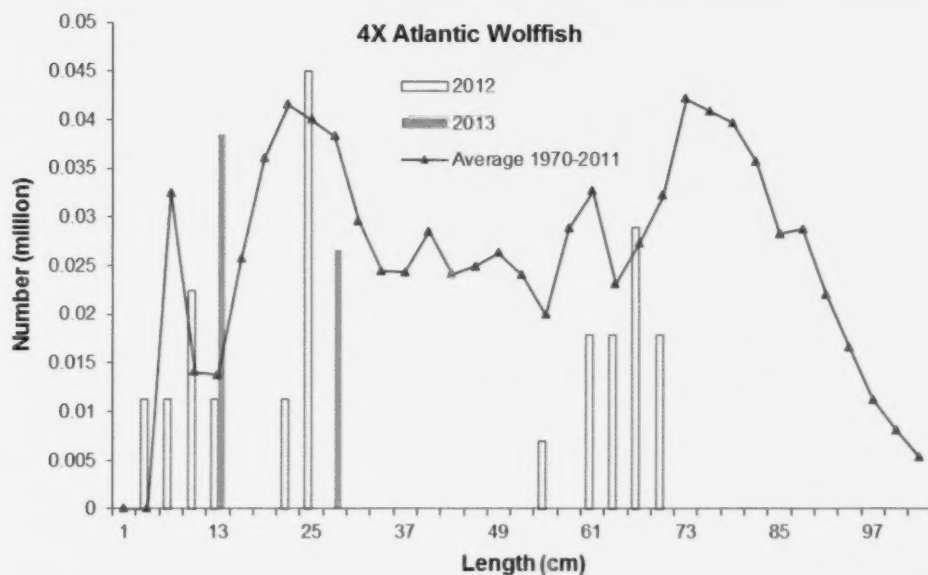


Figure 14c. Length frequency indices for Atlantic Wolffish in 4X from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

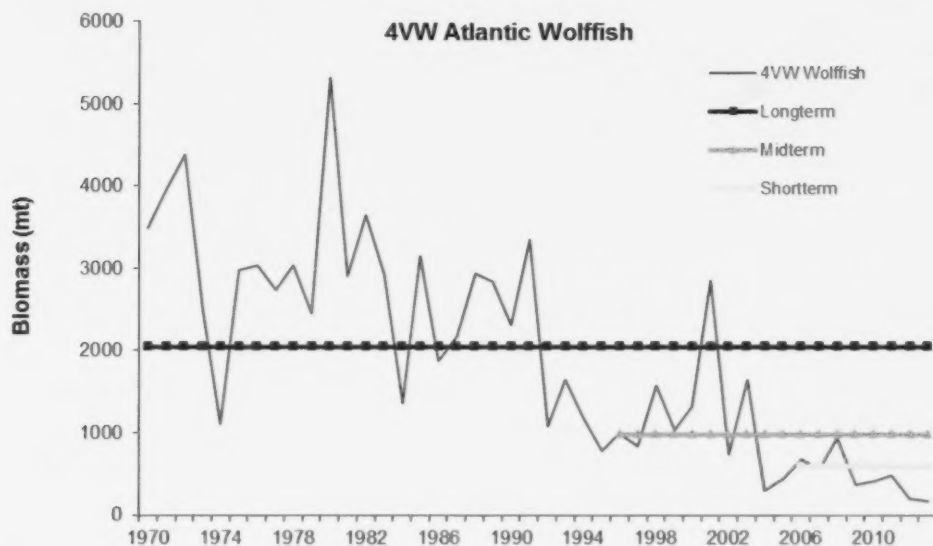


Figure 14d. Biomass index for Atlantic Wolffish in 4VW from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

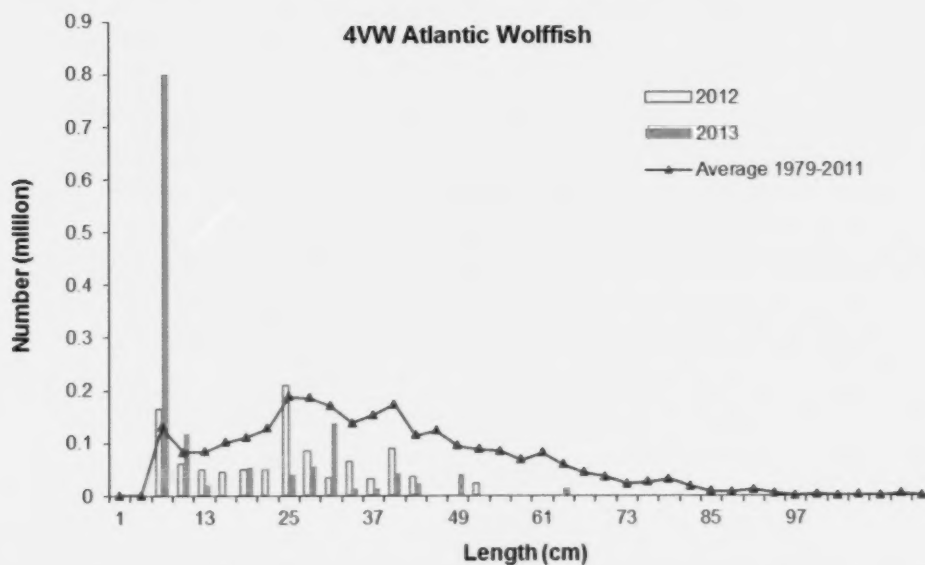


Figure 14e. Length frequency indices for Atlantic Wolffish in 4VW from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

Monkfish

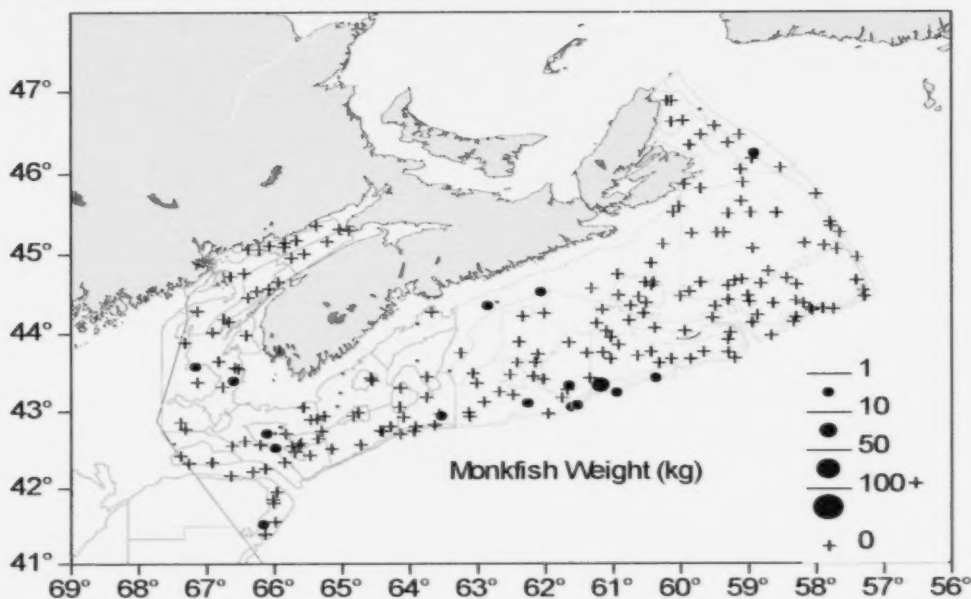


Figure 15a. Distribution of Monkfish catches during the 2013 summer RV survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

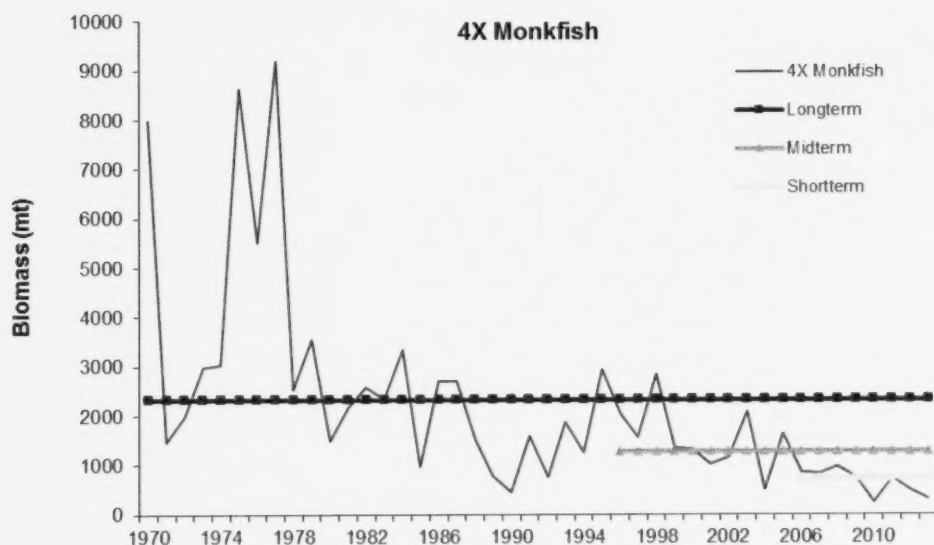


Figure 15b. Biomass index for Monkfish in 4X from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

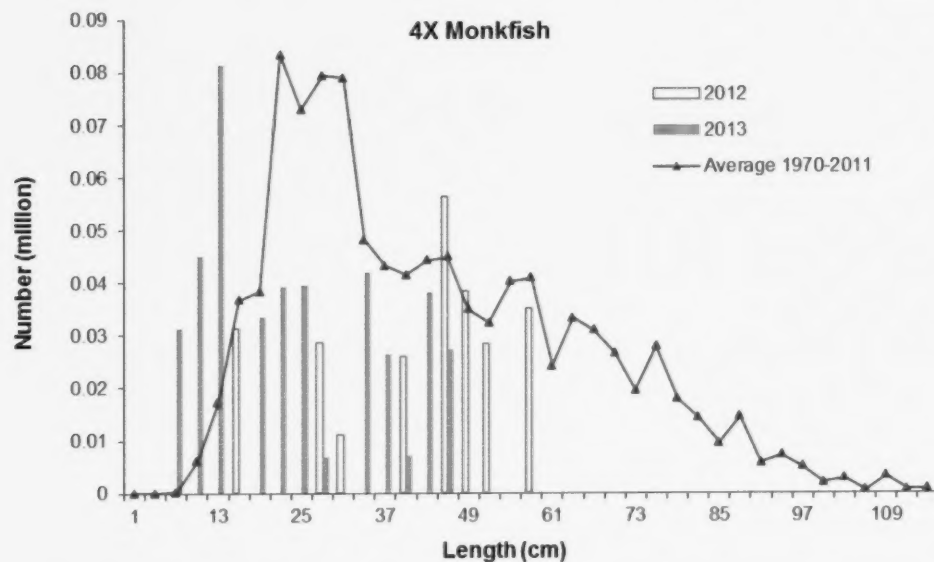


Figure 15c. Length frequency indices for Monkfish in 4X from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

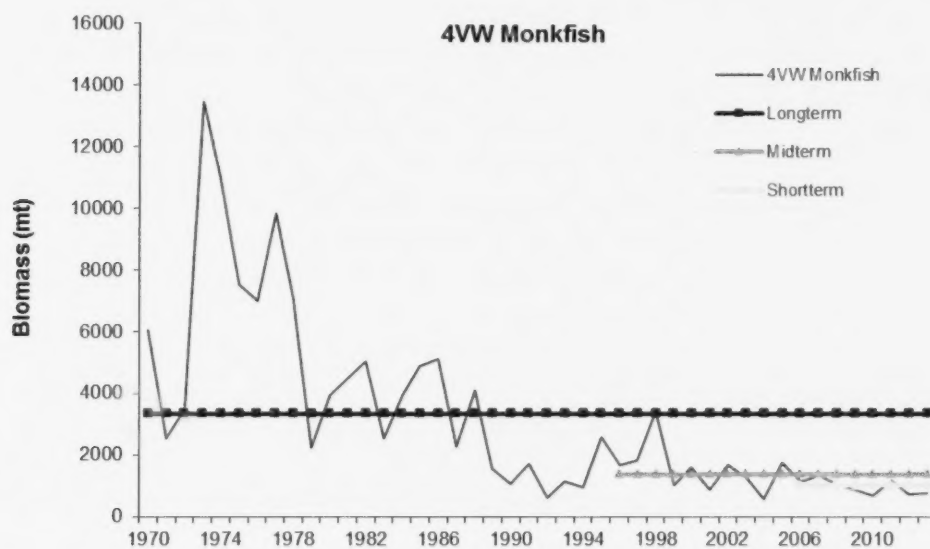


Figure 15d. Biomass index for Monkfish in 4VW from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

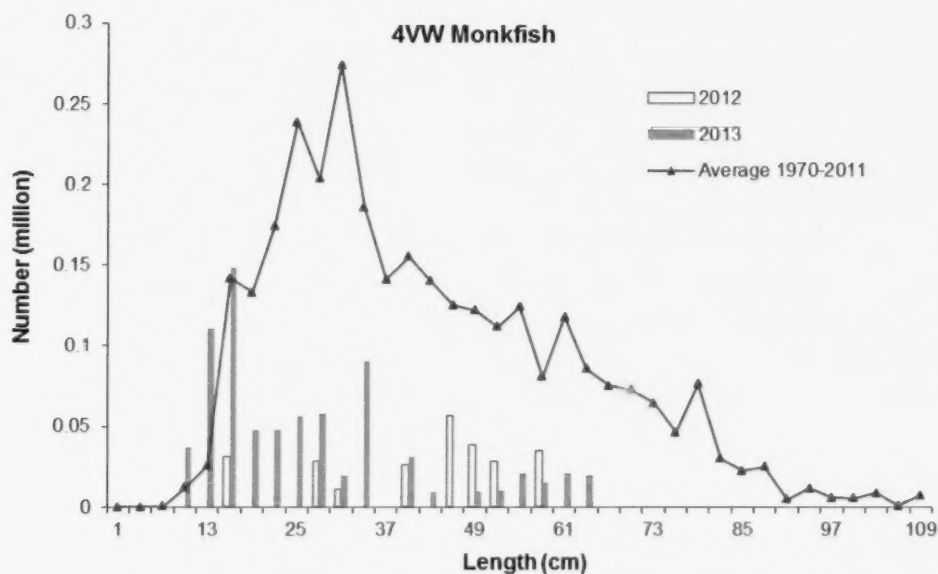


Figure 15e. Length frequency indices for Monkfish in 4VW from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

Smooth Skate

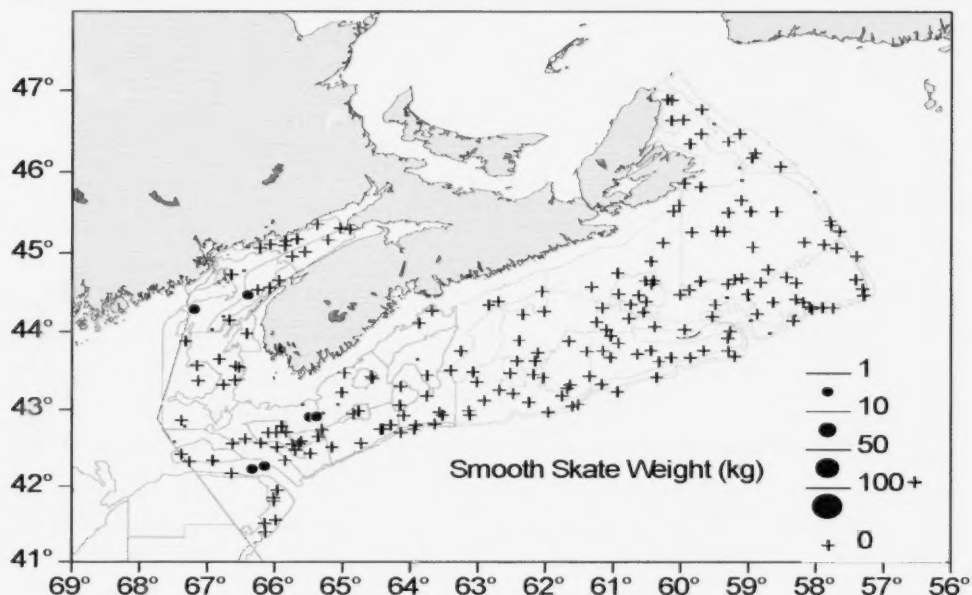


Figure 16a. Distribution of Smooth Skate catches during the 2013 summer RV survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

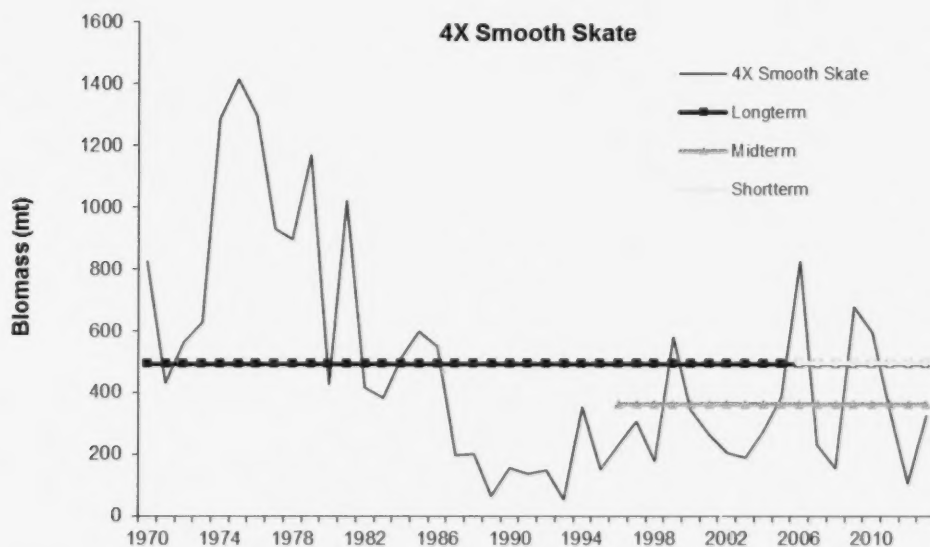


Figure 16b. Biomass index for Smooth Skate in 4X from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

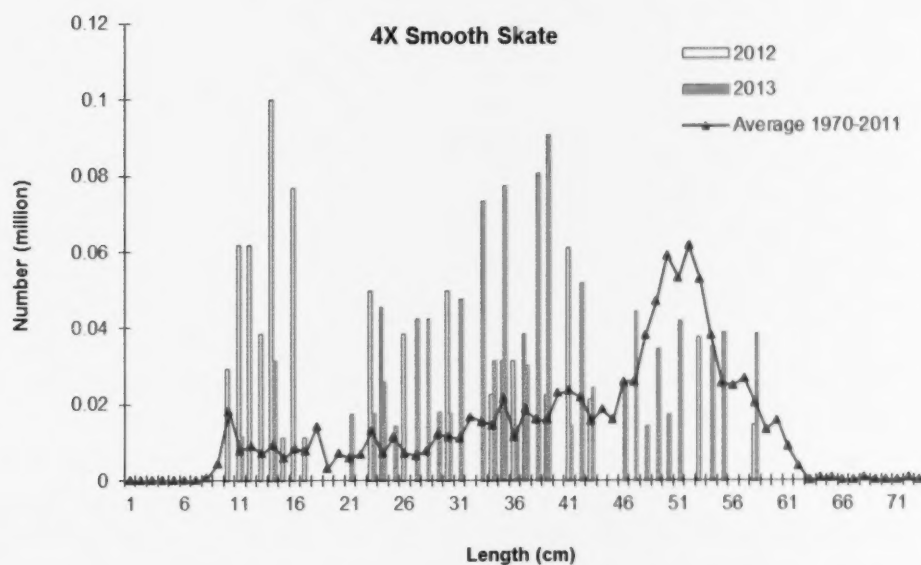


Figure 16c. Length frequency indices for Smooth Skate in 4X from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

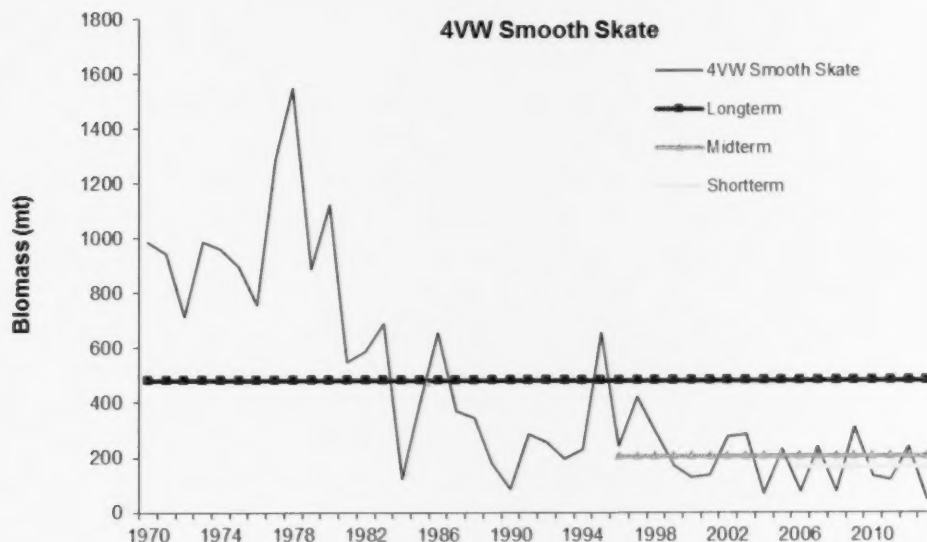


Figure 16d. Biomass index for Smooth Skate in 4VW from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

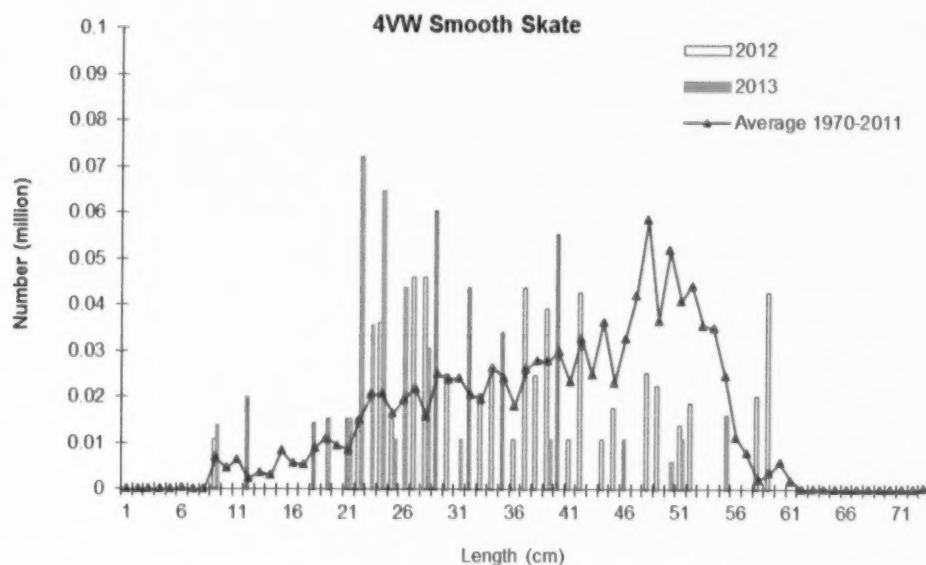


Figure 16e. Length frequency indices for Smooth Skate in 4VW from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

Thorny Skate

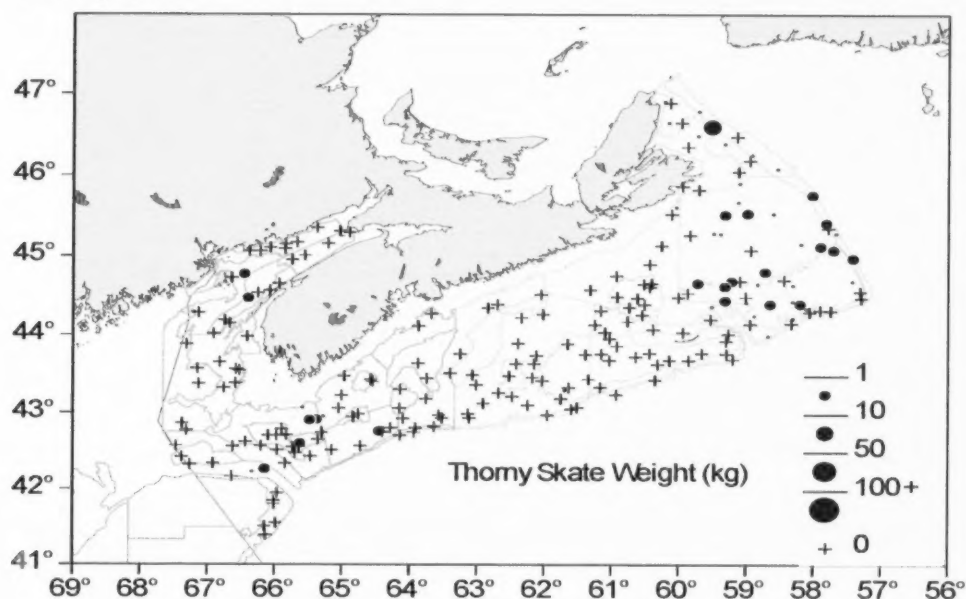


Figure 17a. Distribution of Thorny Skate catches during the 2013 summer RV survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

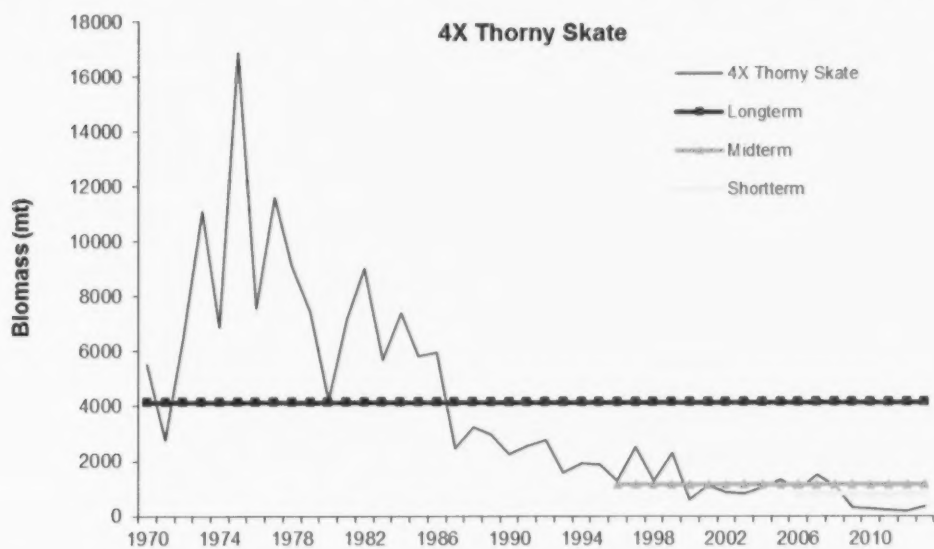


Figure 17b. Biomass index for Thorny Skate in 4X from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

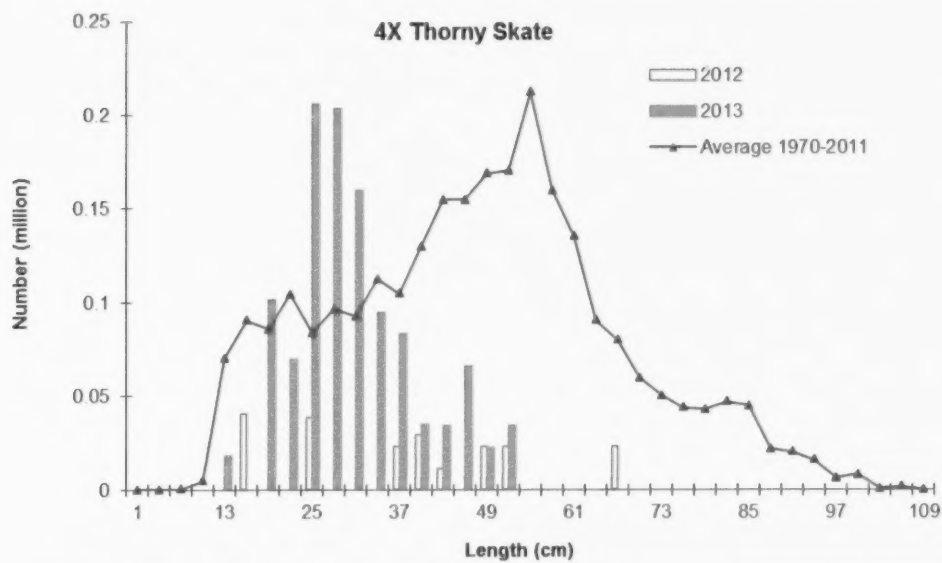


Figure 17c. Length frequency indices for Thorny Skate in 4X from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

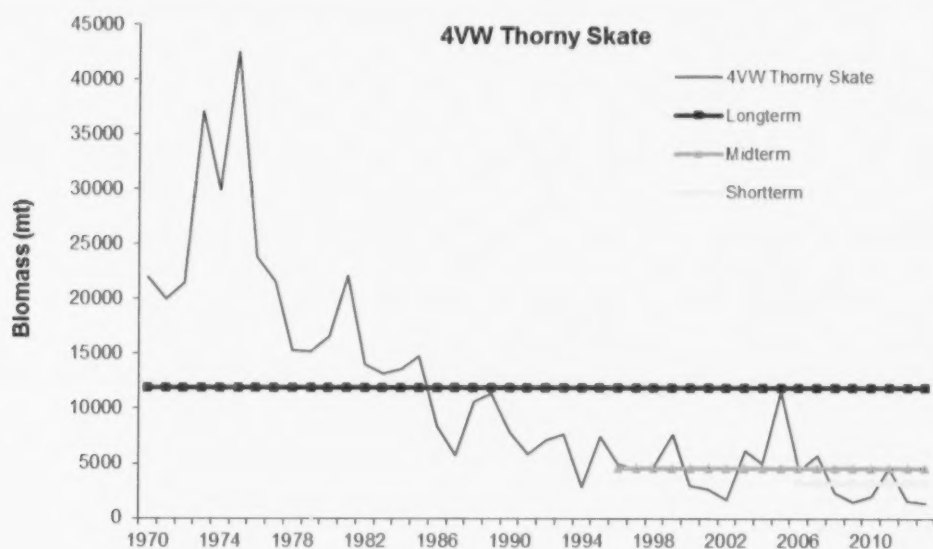


Figure 17d. Biomass index for Thorny Skate in 4VW from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

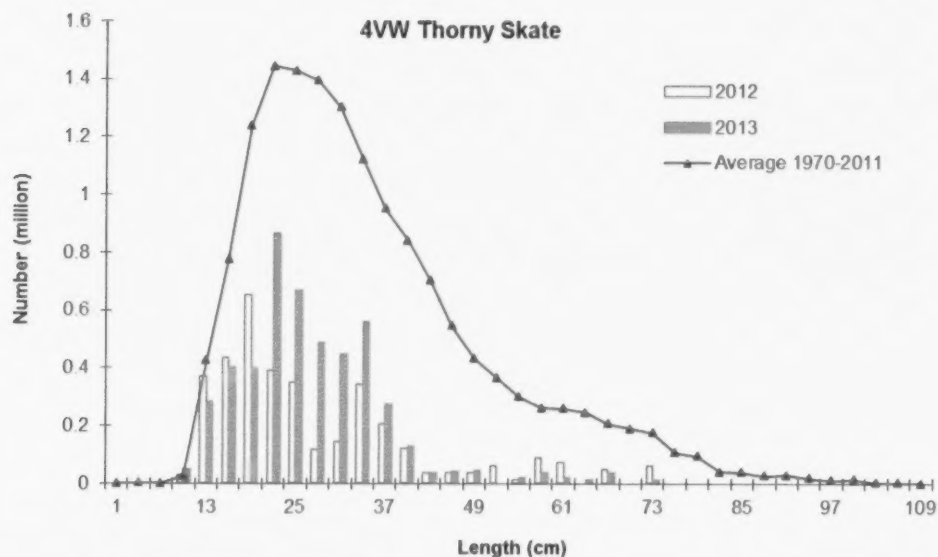


Figure 17e. Length frequency indices for Thorny Skate in 4VW from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

Barndoor Skate

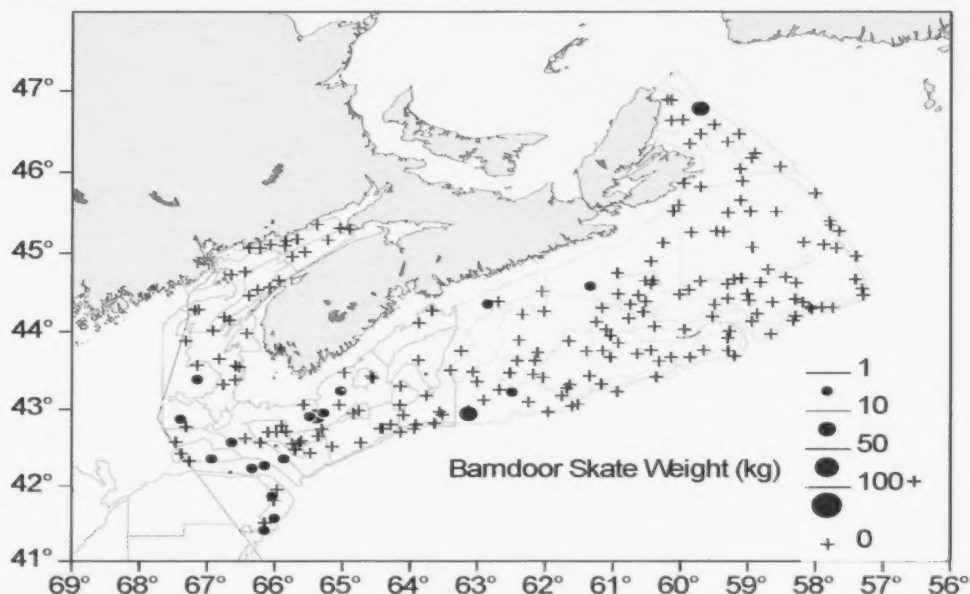


Figure 18a. Distribution of Barndoor Skate catches during the 2013 summer RV survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

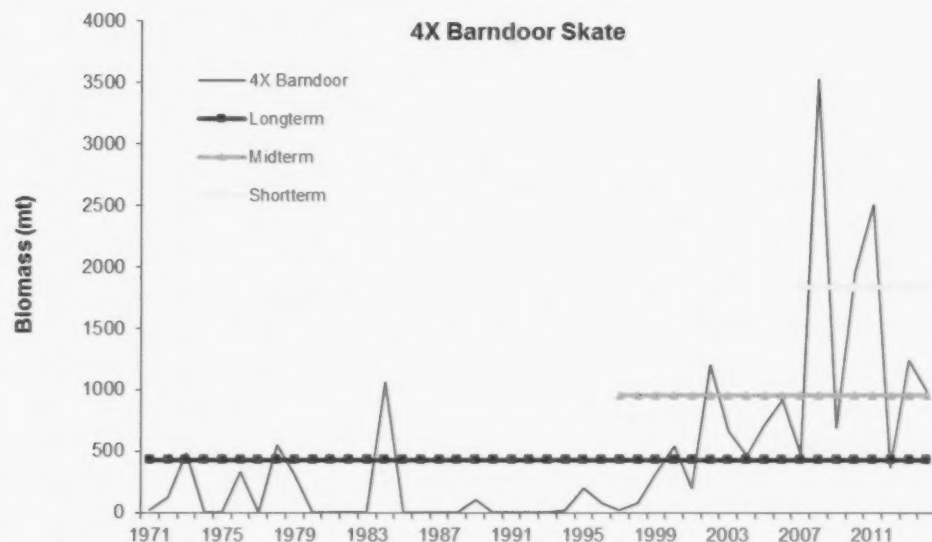


Figure 18b. Biomass index for Barndoor Skate in 4X from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

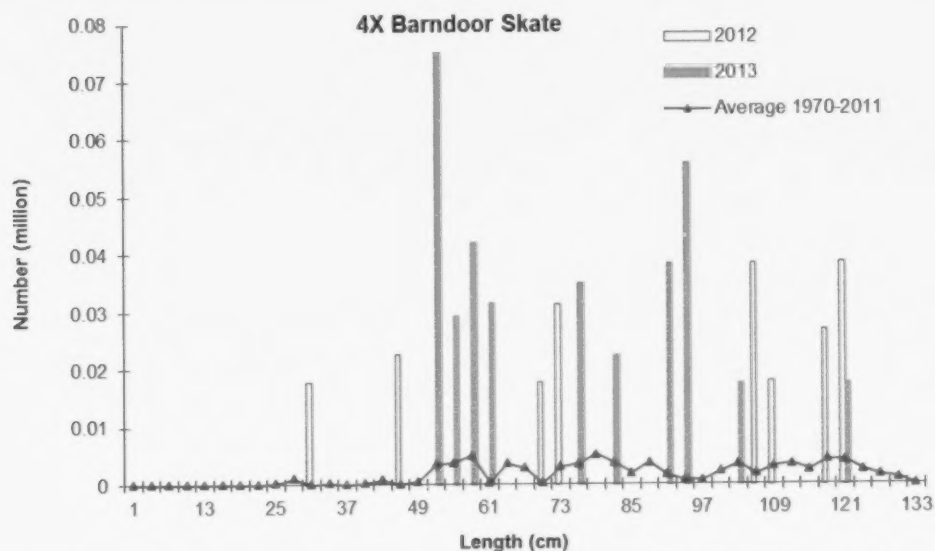


Figure 18c. Length frequency indices for Barndoor Skate in 4X from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

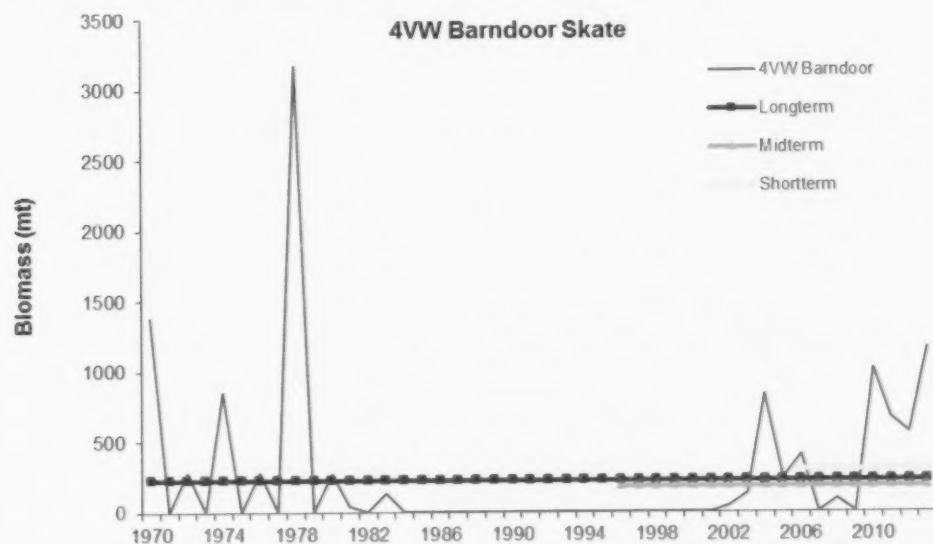


Figure 18d. Biomass index for Barndoor Skate in 4VW from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

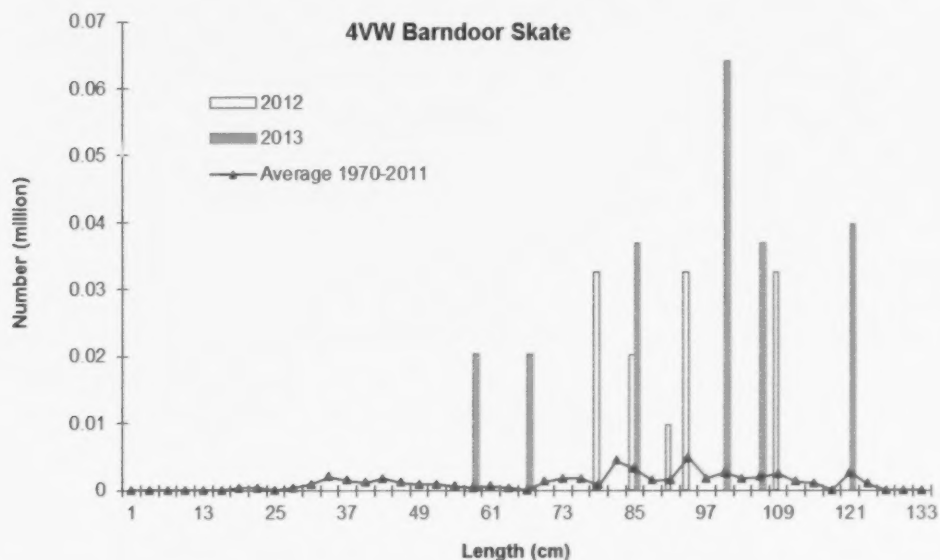


Figure 18e. Length frequency indices for Barndoor Skate in 4VW from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

Winter Skate and Little Skate cannot be reliably distinguished at lengths less than about 40 cm. Given that the majority of the winter and little skates captured in the surveys are in this length range, the biomass trends are influenced by the contribution of fish for which identification is uncertain (for more information see McEachran and Musick, 1973).

Winter Skate

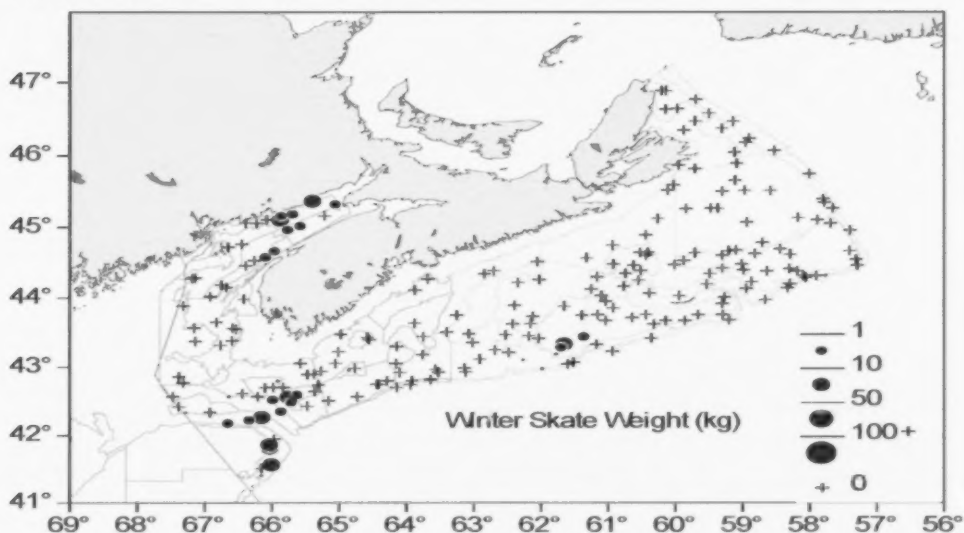


Figure 19a. Distribution of Winter Skate catches during the 2013 summer RV survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

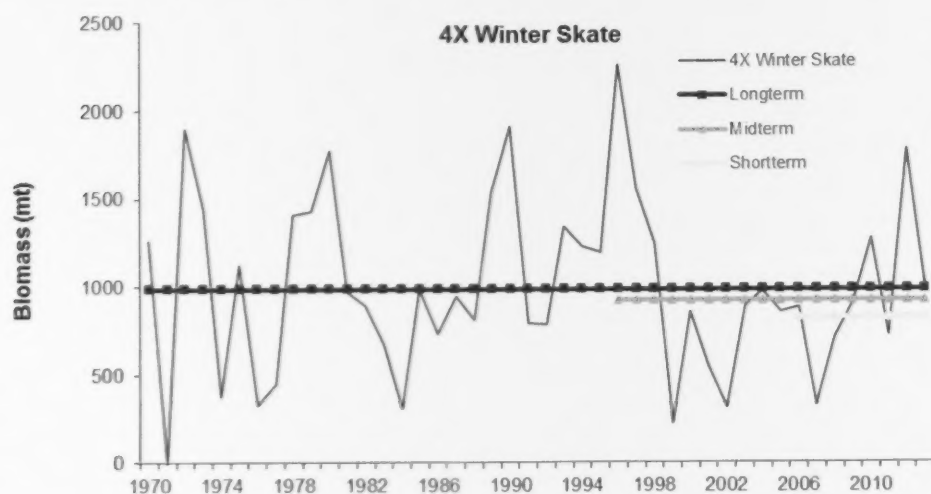


Figure 19b. Biomass index for Winter Skate in 4X from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

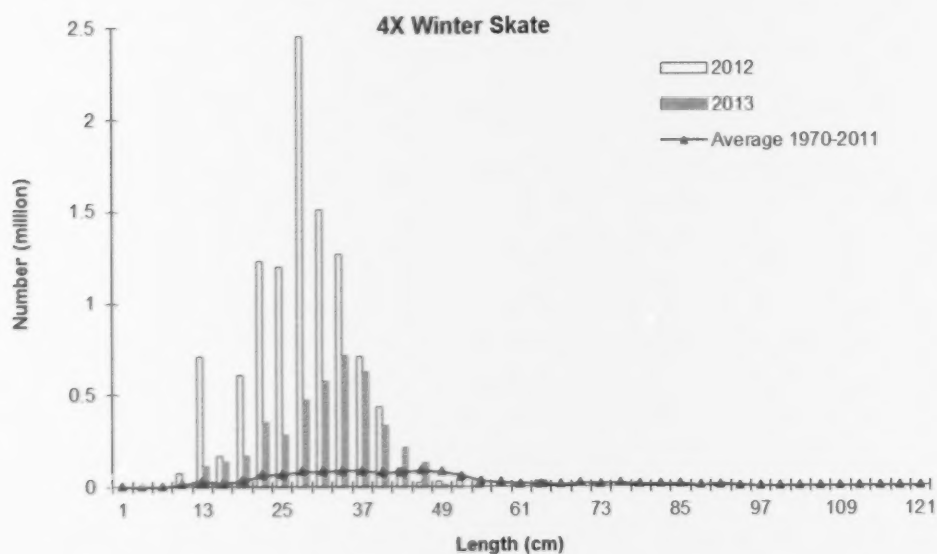


Figure 19c. Length frequency indices for Winter Skate in 4X from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

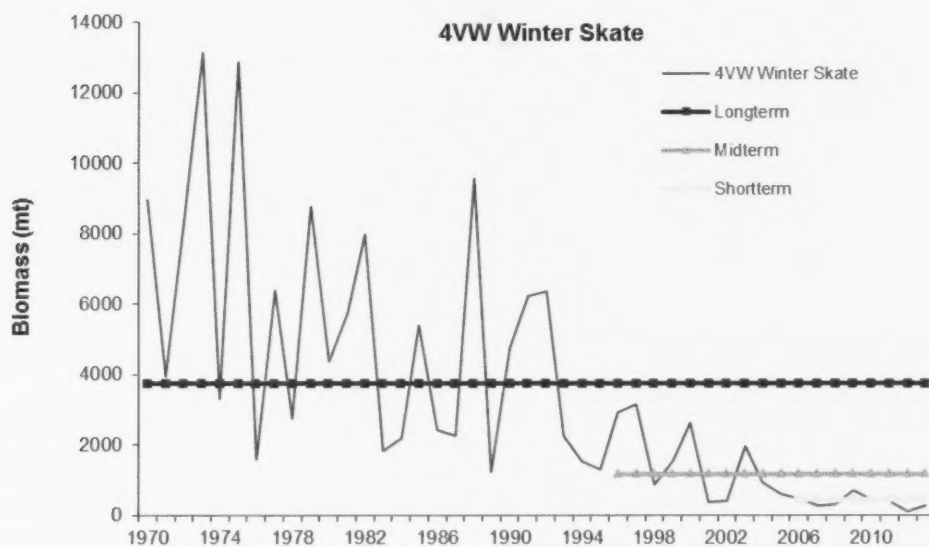


Figure 19d. Biomass index for Winter Skate in 4VW from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

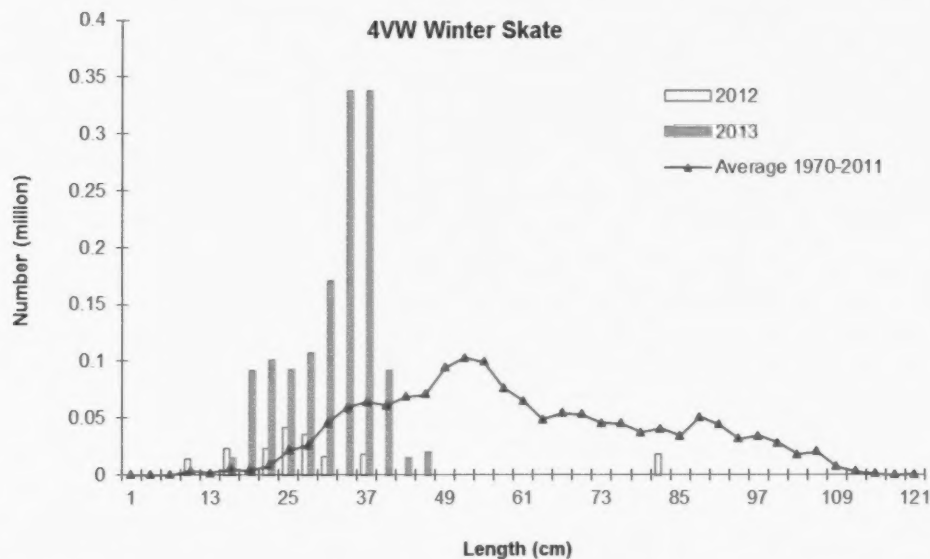


Figure 19e. Length frequency indices for Winter Skate in 4VW from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

Little Skate

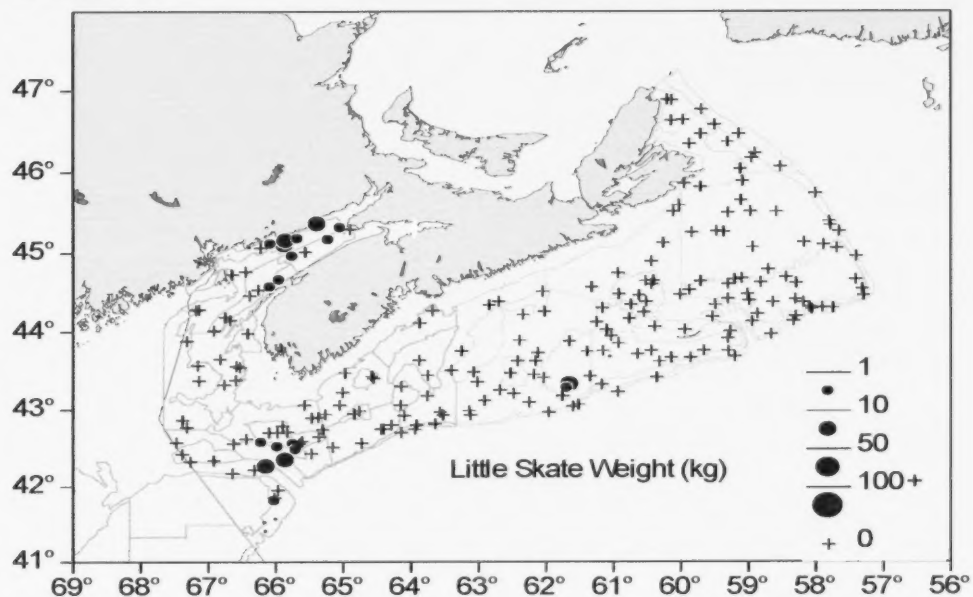


Figure 20a. Distribution of Little Skate catches during the 2013 summer RV survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

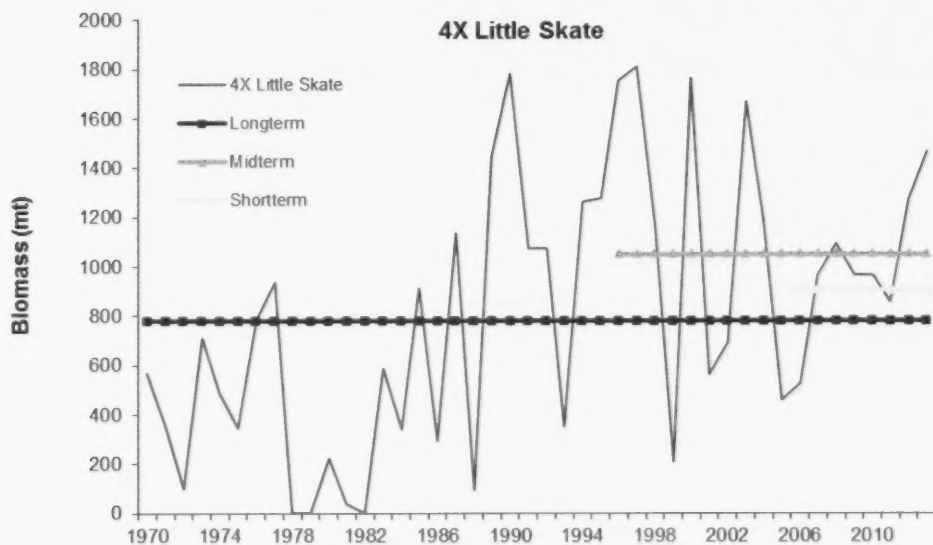


Figure 20b. Biomass index for Little Skate in 4X from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

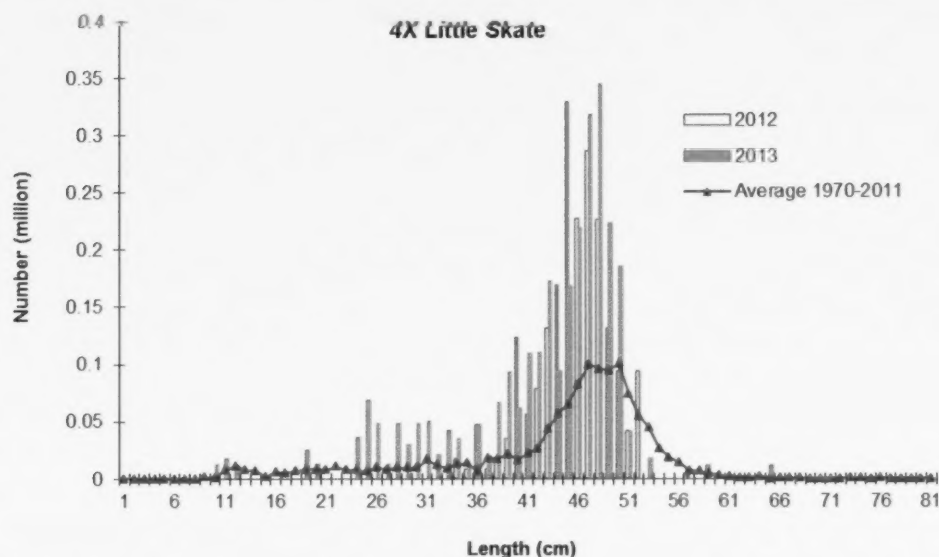


Figure 20c. Length frequency indices for Little Skate in 4X from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

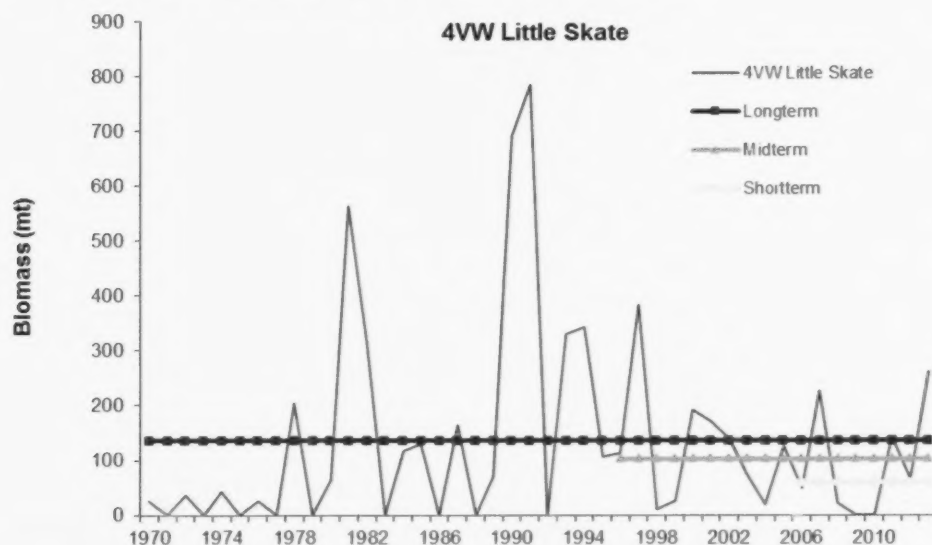


Figure 20d. Biomass index for Little Skate in 4VW from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

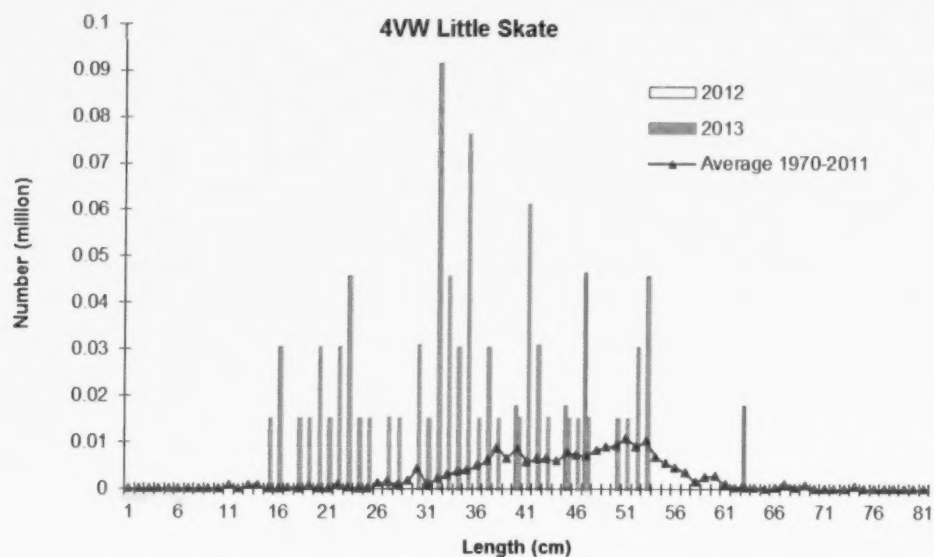


Figure 20e. Length frequency indices for Little Skate in 4VW from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

Spiny Dogfish

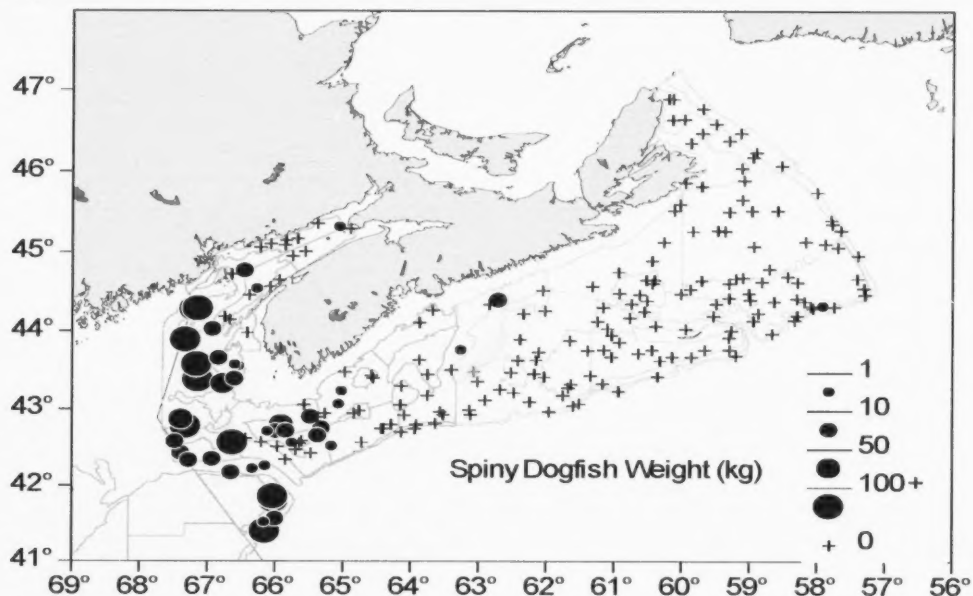


Figure 21a. Distribution of Spiny Dogfish catches during the 2013 summer RV survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

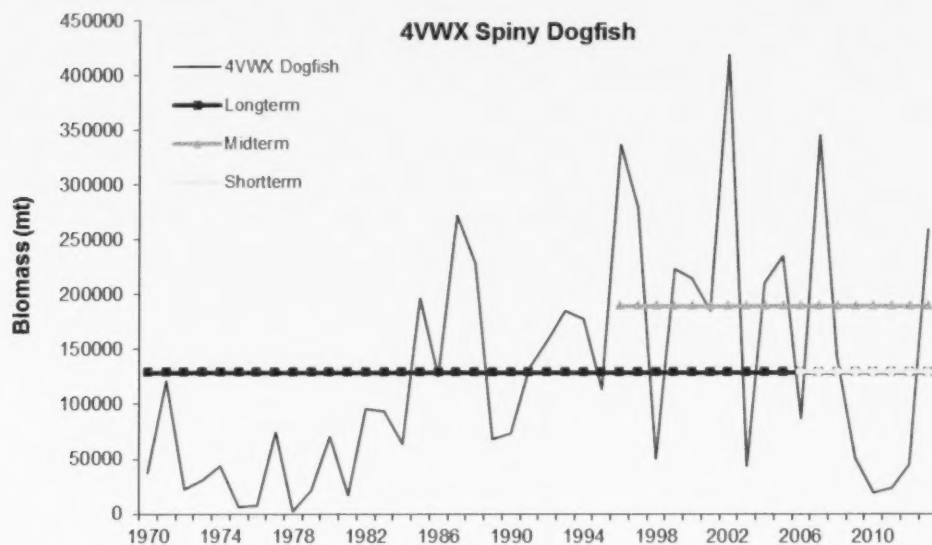


Figure 21b. Biomass index for Spiny Dogfish in 4VWX from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

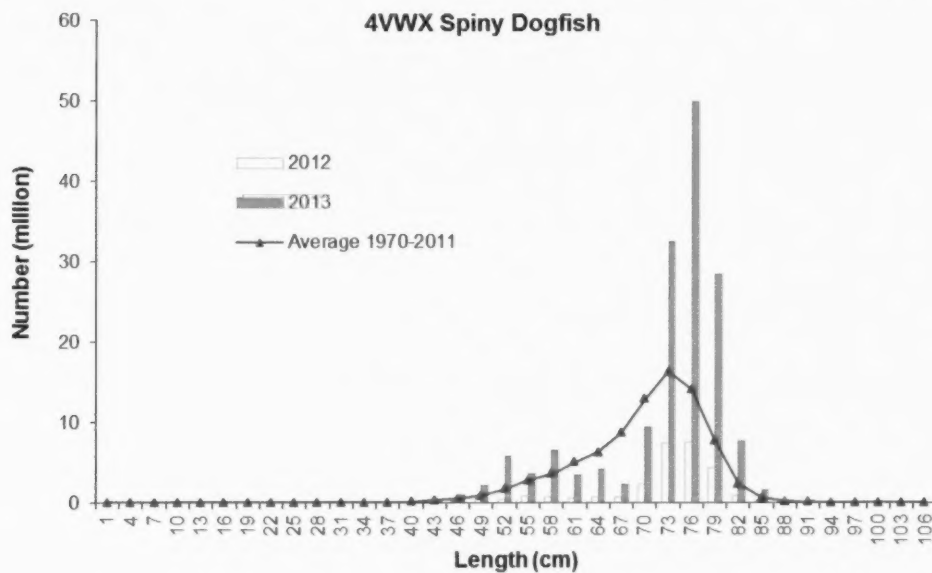


Figure 21c. Length frequency indices for Spiny Dogfish in 4VWX from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

Longhorn Sculpin

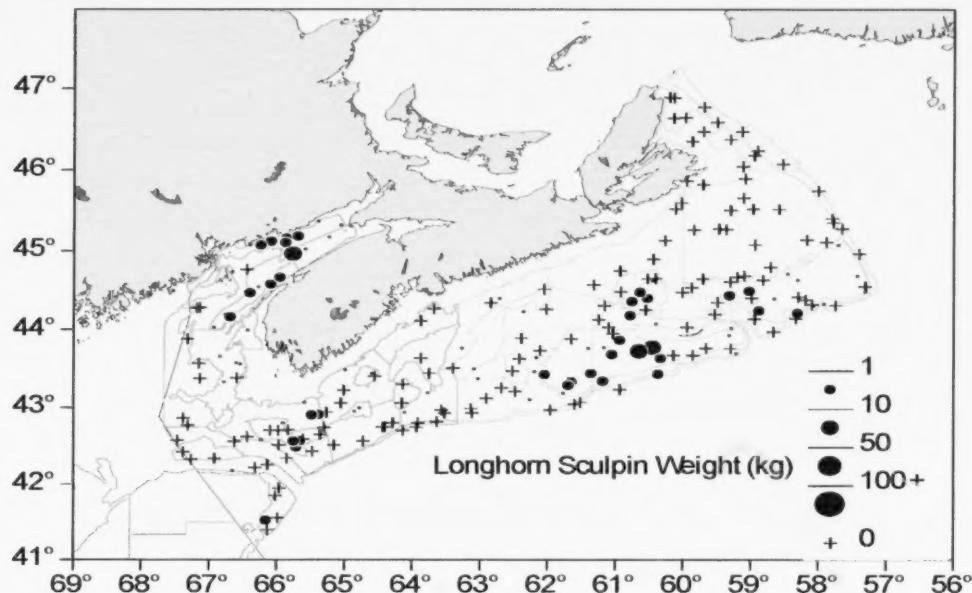


Figure 22a. Distribution of Longhorn Sculpin catches during the 2013 summer RV survey. Zero catch is represented by the + symbol. Black circles represent catches. The circle area is proportional to the catch size.

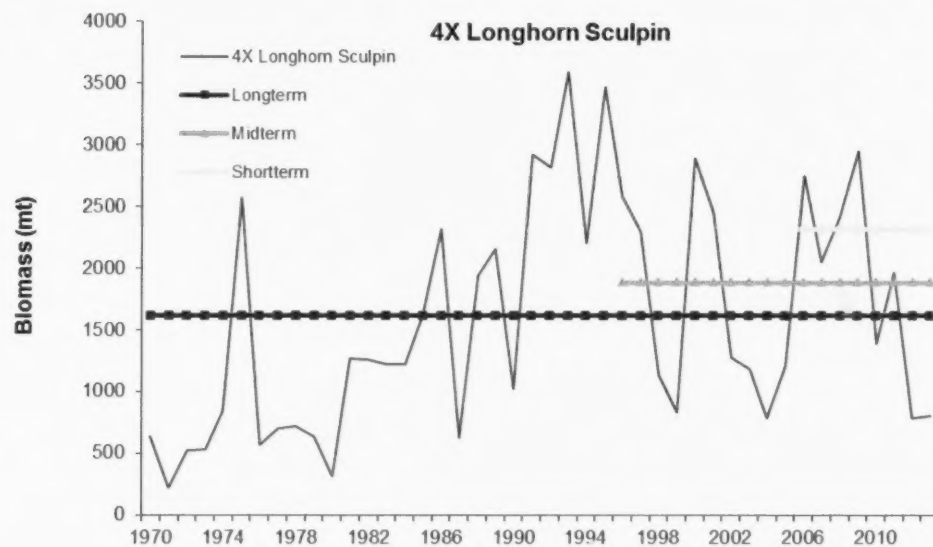


Figure 22b. Biomass index for Longhorn Sculpin in 4X from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

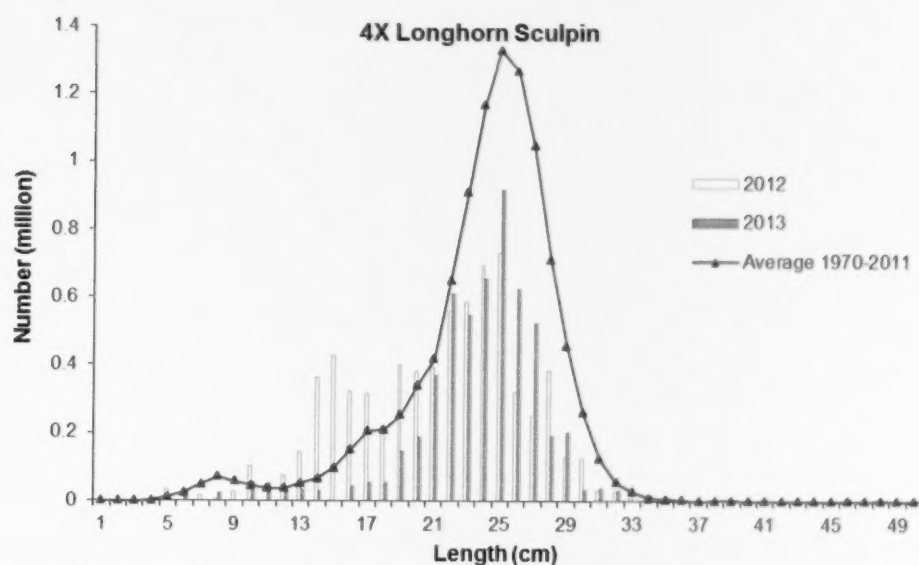


Figure 22c Length frequency indices for Longhorn Sculpin in 4X from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

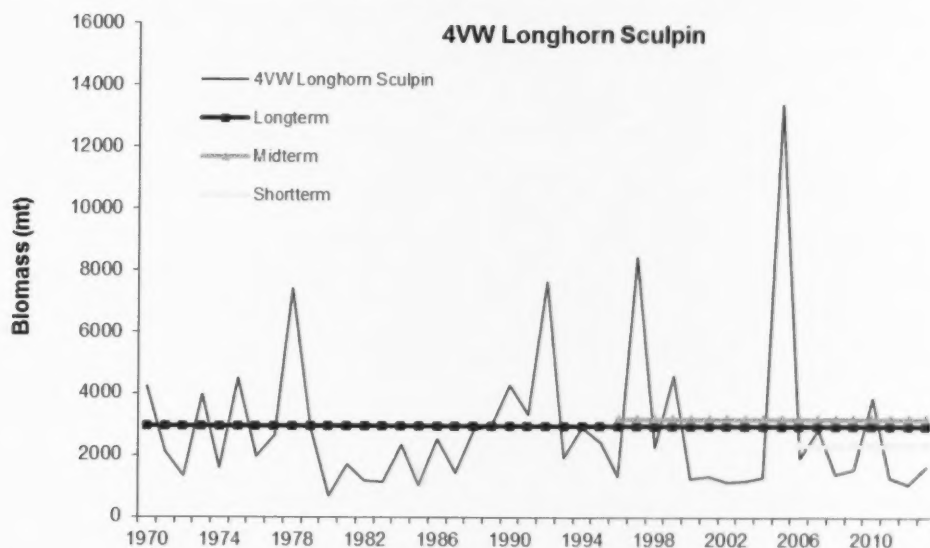


Figure 22d. Biomass index for Longhorn Sculpin in 4VW from the summer RV survey represented by the solid black line. The dark blue line with the solid squares indicates the long-term survey average (1970-2011). The pink line with the solid triangles represents the medium-term 15 year average (1997-2011). The light blue line with the solid circles represents the short-term 5 year average (2007-2011).

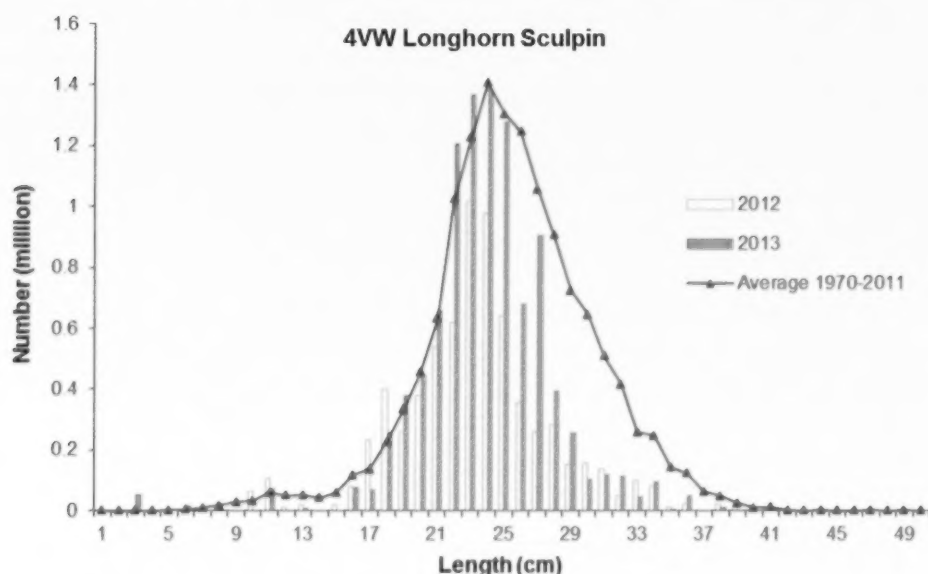


Figure 22e. Length frequency indices for Longhorn Sculpin in 4VW from the summer RV survey. The solid red bars represent the number in millions at length from the 2013 survey. The open green bars represent the number in millions at length from the 2012 survey. The solid blue line with triangles represents the average number in millions at length for the time period 1970-2011.

Conclusions

Biomass indices are compared with the averages over 3 time periods; short-term being most recent 5 year average, mid-term being most recent 15 year average and long-term being since the beginning of the survey series, or the period deemed appropriate for that particular species. A comparison of length frequency indices for 2012 and 2013 with the long-term average from the beginning of the survey series, or the period deemed appropriate for that particular species, to 2011 is also presented.

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